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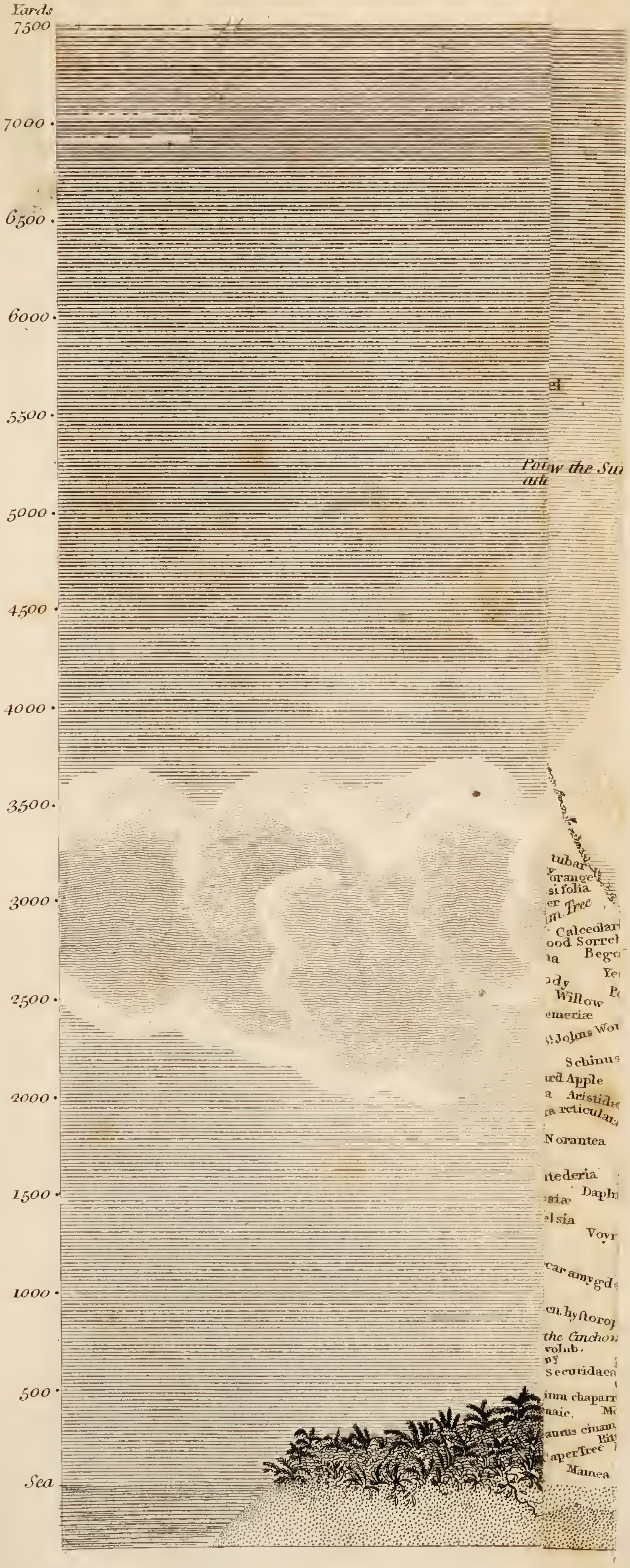
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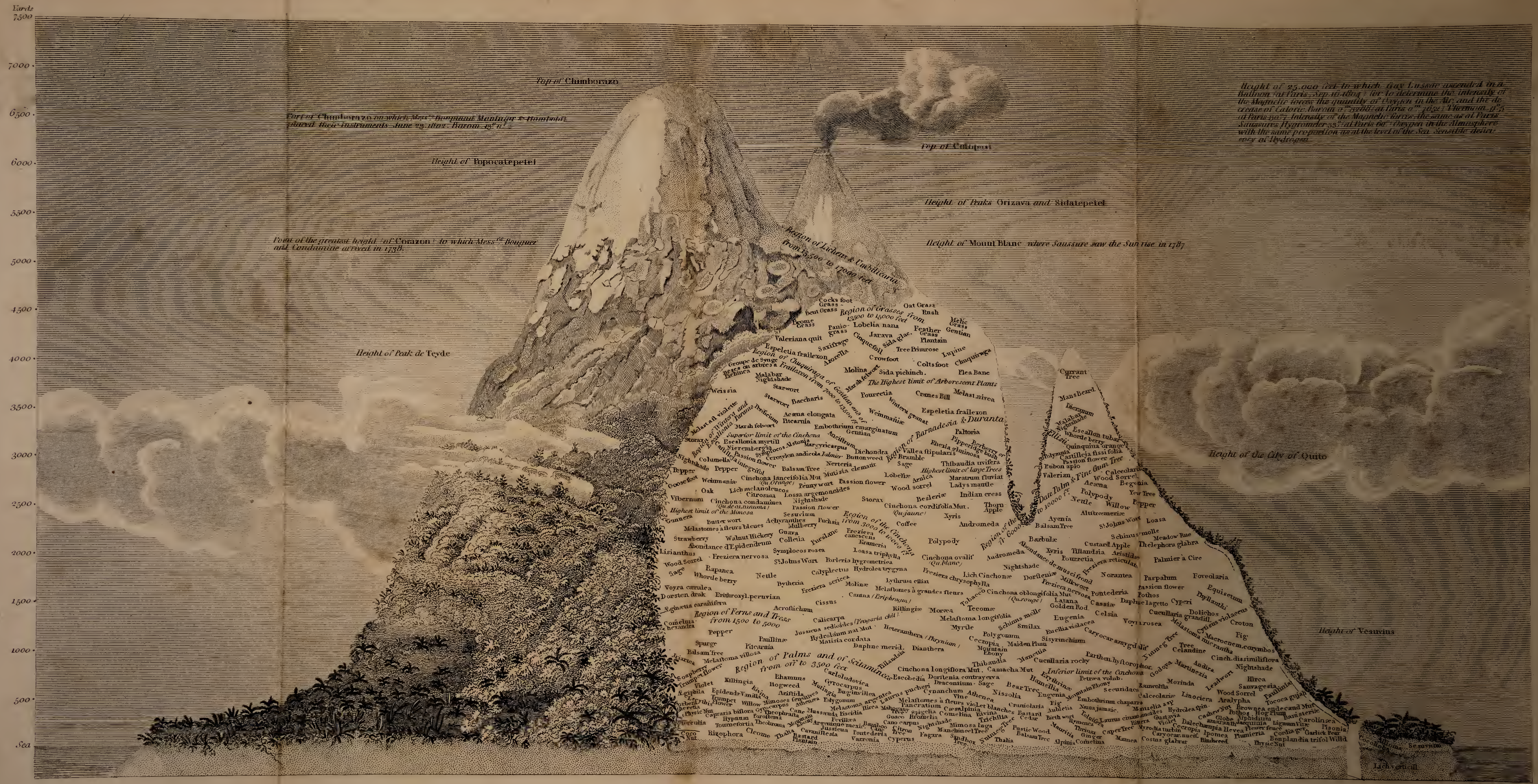

PROGRESS OF VEGETATION AT DIFFERENT ELEVATIONS.

NATURE DISPLAYED

IN THE

HEAVENS

AND

ON THE EARTH

ACCORDING TO THE LATEST

OBSERVATIONS AND DISCOVERIES.

By SIMEON SHAW, L.L.D.

Say, why was Man so eminently raised
Amid the vast creation; why empowered
Through life and death to dart his watchful eye,
With thoughts beyond the limit of his frame;
But that the OMNIPOTENT might send him forth,
In sight of angels and immortal minds,
As on an ample theatre to join
In contest with his equals, who shall best
The task achieve, the course of noble toils,
By wisdom and by mercy preordained?
Might send him forth the sov'reign good to learn;
To chase each meaner purpose from his breast?
And through the mists of passion and of sense,
And through the pelting storms of chance and pain,
To hold straight on with constant heart and eye,
Still fixed upon his everlasting palm,
The approving smile of HEAVEN? AKENSIDE.

IN SIX PARTS.

PART VI.

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CONTENTS

OF

PART VI.

Page.

LECTURE LXXIII.

The Linnæn System …… 337
The Natural System of Jusieu …… 339
Divisions of a Plant …… 340
Varieties of Coralla …… 343*
Insects in Coralla …… *ibid*
The Nectariam …… 344*
Seeds described …… 347*
Roots described …… 349*
Trunks described …… *ibid*
Leaves described …… 351*
The 24 Classes described …… 352*
The Classes and Orders enumerated …… 343

LECTURE LXXIV.

The Geography of Plants …… 345
Number of known Plants …… 346
Their Climate and distribution …… *ibid*
Vegetation of Mountains …… 347
American Forests described …… 348
Oriental Vegetation …… 349
Vegetation of the Temperate Zone …… 350
Northern Temperate Zone …… 351
Mountains and Climates contrasted …… 352
Physiology of Plants …… 355
Bulbous and other Roots …… 357
Grafting and Inoculation …… *ibid*
Mrs Ibbetson's Microscopic Observations and Discoveries …… 359

LECTURE LXXV.

On British Forest Trees …… 363
Oak …… *ibid*
Beech …… 366
Chesnut …… 367
Ash …… 368
Poplars …… 369
Aspen …… 370
Occidental or Virginian Plane …… 370

Page.
Birch 371
Elm ibid
Weeping Willow 372
Yew 372
The Cypress 373
Lime ibid
Walnnt ibid
Holly 374
Elder ibid
Firs 375
Scotch Fir ibid
Spruce Fir 376
Silver Fir ibid
Weymouth Pine 377
Larch ibid
Wild Pine 378
Cedar ibid

LECTURE LXXVI.

Tropical Trees and Plants 381
Palm Tribe ibid
Palmetto 384
Lemon Tree 385
Orange Tree ibid
Japanese Citron 386
Sugar 388
——— Cane ibid
Coffee Tree 395
——— Arabica ibid
Tea 400
Cacao 404
Vanilla 407
Cocoa Tree ibid
Cocoa Nut Tree ibid
Tobacco 410
Cotton Tree 413
Barbadoes Cotton Tree 414
Indigo 416

LECTURE LXXVII.

Tropical Trees and Plants Continued 418
Fig Tree ibid
Banian Tree 419
Peipal 421
Nutmeg Tree 422
Clove Tree 425
Bay Tribe 426
Cinnamon Tree ibid
Cassia or Wild Cinnamon 428
Camphor Tree ibid
Common Sweet Bay 429

Page.
Royal Bay or Indian Laurel 430
Sassafras Tree .... ibid
Myrrh Laurel .... ibid
Laburnum .... ibid
Coral Tree 431

LECTURE LXXVIII.

Tropical Trees and Plants Continued 431
Pimento or Jamaica Pepper .... ibid
Ebony Tree 432
Fountain Tree .... ibid
Wax bearing Myrica, or Candleberry Myrtle 433
Indian Arrow Root 434
Tamarind Tree 435
Silver Tree 436
Balsam of Tolu Tree .... ibid
Pomegranate Tree .... ibid

LECTURE LXXIX.

Tropical Trees and Plants Continued 437
Bread Fruit Tree, 2 species .... ibid
Plantain Tree 439
Banana Tree 440
Elm Leaved Sumach 441
Virginian Sumach, or Vinegar Plant .... ibid
Great American Aloe 442
Sponge Plant .... ibid
Cipo 443
Anisatum or Anise Tree 444
Rhubarb .... ibid
Chinese Rhubarb .... ibid
Tartarian Rhubarb .... ibid
Undulated or Waved-leaved Rhubarb 445
Currant Rhubarb .... ibid

LECTURE LXXX.

Tropical Trees and Plants Continued 446
Olive .... ibid
Cape Olive 447
Sandal Tree 448
Cinchona, or Jesuits Bark .... ibid
——— Officinalis 449
Yellow Bark 450
Upas or Poison Tree 451
Anchar .... ibid
Teak Tree 452
Storax Tree 453
——— Benzoin 454
——— Liquid Storax .... ibid
Elemifera Tree .... ibid
Gileadensis, or Balm of Gilead .... ibid
Balsamifera, or Rosewood .... ibid

Page.
Catechu ... 455
Nilotica ... *ibid*
Cashew Nut Tree ... *ibid*
Butter Tree ... 456
Betel Tree ... *ibid*
Mangrove ... 457
Cork ... 458
Bamboo ... *ibid*
——— Tebor ... 459
Syringe Tree ... *ibid*
Papyrus ... 460
Tallow Tree ... 462
Rice ... *ibid*
Camphor Tree of Sumatra ... 463
Rattle Snake Wort ... *ibid*
Stapelai ... *ibid*
Nepenthes Distillatoria ... 464
Gourd or Pumpkin ... *ibid*
Cypress of Louisiana ... 465
Jalap ... *ibid*
Polypodium or Tartarian Lamb ... *ibid*

LECTURE LXXXI.

On the Sensitive and Chemical Powers of Plants, with Examples ... 466
Linné's enumeration of Sensitive Flowers ... 467
Sensitive Tribe ... 470
Bashful Humble Plant ... *ibid*
Slothful Mimosa ... *ibid*
Asperata ... 471
Viva, Lively Mimosa ... *ibid*
Scandens ... *ibid*
Dicnea Muscipula ... 473
Venus s Fly-trap ... 474
Sombrero ... 475
Averrhoa Carambola ... 476
Animated Hedysarum or Moving Plant ... *ibid*
The Sleep of Plants ... 478
Action of Plants on the Atmospheric Air ... 479
The Colouration of Plants ... 481
On the Temperature of Vegetables ... 483

LECTURE LXXXII.

British Vegetation, detailing the varieties of Grasses, Grains, Fruits, &c. ... 485
Wheat ... 488
Oats ... 419
Potatoes ... 490
Beans, Peas ... *ibid*
Common Flax ... 491
Perennial Siberian Flax ... *ibid*

Page.
Purging Flax 491
Mustard ibid
Kali 492
Madder ibid
Thistle 493
Misletoe ibid
Holly 494
Box Tree ibid
Lichens ibid
Liver Wort 495
Fruit Trees 496
Mulberry Tree 497
Vine ibid
Melon ibid
Common Red Currant Tree 498
——— Black Currant Tree ibid
——— Gooseberry Bush ibid
Prickly Fruited Gooseberry Bush ibid
Strawberry Tree 499

LECTURE LXXXIII.

On Flowers, and their beauties 499
Their parts, formation, and varieties 502
Remarkable Specimens, exotic and native 503

LECTURE LXXXIV

On the Climates of the Earth, and on the Distribution of Organized Productions 514
Causes of different Climates 514
Average Temperature of different Latitudes 516
Temperature of Mountains 517
Local causes of Temperature 518
Productions of different Climates 519
Deserts described 520
Productions of the Torrid Zone 521
——— of the Polar Circles 522
Climate of Fishes and Amphibia 523
Climates of America 527
Humboldt's Account of the Torrid Zone 529
Climate of Africa ibid
——— of India 530
Storms of the Torrid Zone 531
Winds explained 532
Rains explained 533
Phenomena of the Frigid Zone 534
——— Temperate Zones 535

LECTURE LXXXV.

Chain of Being in the Universe 536
Links of Vegetables 537
Connection of Vegetable and Animals 544

Page.
First appearances of Animation 545
Links of Animals 547
Insects 549
Crustacea 551
Stomachs of Animals 553
Polypi 554
Infusoria 555
Caterpillars 557
Spider 558
Moluscus *ibid*

LECTURE LXXXVI.

Comparison of the Analogy and Differences of Animals, Birds, and Fishes 560
General Character of Vertebrated Animals *ibid*
Mechanism of Fishes *ibid*
———— of Serpents and Reptiles 561
———— of Birds 562
Common properties of all 563
General Classification *ibid*
Mammalia compared 565
Birds compared *ibid*
Fishes compared 566
Bones compared *ibid*
Muscles compared 567
Articulated Members compared *ibid*
Wings compared *ibid*
Swimming Bladder of Fishes 568
Brains compared *ibid*
Senses compared *ibid*
Cuticles compared 570
Claws, Hoofs, and Horns compared *ibid*
Hairs compared 571
Skins compared 572
Organs of Vision compared *ibid*
———— of Mastication compared 573
Stomachs compared 574
Intestines compared 575
Hearts compared *ibid*
Respiration compared 576
Voices compared 577
Peculiar Secretions compared *ibid*
General qualities of Animals 578
Final cause of Animal existence 579
The Doctrine of Instinct examined 580
Foundation of Morals 583

LIST OF THE PLATES.

PART VI.—VOL. III.

Progress of Vegetation at different Elevations .. *To face Title.*
Dense Woods of Brazil, with a Troop of Puris Indians 350
24 Classes of Vegetables according to the Linnæan System 356
Roots 358
Mrs. Ibbetson's Microscopical Discoveries—Plate I. Plate II. Plate III. 360
Oak—Pollard 364
Beech—Birch 366
Sycamore—Thorn 367
Laburnum—Laurel 368
Ash—Poplar 369
Aspin—Pollard 370
Elm—Lopped Elm 371
Pollard—Weeping Willow and Yew 372
Lime—Holly 373
Walnut—Willow 374
Elder—Larch Fir 375
Pollard Willow—Weeping Willow 376
Palm—Italian Pine 377
Cedar—Cypress 378
Scotch Fir—Spruce 379
Date, Aloe, Cocoa, Palm, and Mosquito 384
Lemon Tree 386
Orange Tree 388
Sugar Canes 390
Coffee Tree 396
Tea Tree 400
Tobacco 410
Cotton Tree 412
Common Fig Tree 418
The Banian Tree 420
Nutmeg Tree 422
Clove Tree 424
Cinnamon Tree 426
Pimento, Jamaica Pepper 432
Bread Fruit Tree 438
The Plantain Tree 440
The Banana, Mangrove, and Silk Worm 442
Rhubarb 444
The Papyrus 460
Sensitive Plant, Benzoin, &c. 470
Grasses 486
Common Flax 492
Vine Leaf, &c. 497
Saffron Crocus 502
The Seasons exemplified 534
Euphorbia and Coccus Plant and Insect 536
Nine Skulls of Men and Animals 562
Six Skulls of Animals and Skeleton of a Cat 564
Comparative Physiognomies—Comparative Legs 572

DESCRIPTION

OF THE

ENGRAVINGS IN PART VI.

PROGRESS OF VEGETATION AT DIFFERENT ELEVATIONS.

M. Humboldt, for the purpose of exemplifying the heights at which various trees and plants will not flourish, has prepared this representation of a mountain, on one side of which he has represented the decrease of vegetation in a picturesque manner, and on the other has expressed the names of the several plants and trees which will flourish at the respective heights. It is a study at once most curious and useful. We have endeavoured, as often as possible, to give the common names of the plants. It appears, by examination of this engraving, that every plant has a determinate planet; and, as the mountains of the torrid zone afford every variety of climate between their base and their summit, so they are capable of producing all the vegetables of every climate; but, as the temperature diminishes as the latitude increases, so, generally speaking, the productions, as we proceed from the tropics northward or southward, correspond with the elevation at which the same plants will grow upon a mountain within the tropics. Every plant requires other circumstances alike: a mean annual temperature, for example. The magnificent plantain and useful sugar-cane require a mean annual heat of 82° to 73°; but 73° of mean annual heat is not found beyond the 27° of latitude; consequently, the plantain and sugar-cane will not ripen in the open air in a higher latitude: and this M. Humboldt has found to correspond with the altitude of 1000 yards under the equator. In like manner, the cotton-plant will not flourish without 68° of heat, which is not found beyond 34°; which corresponds with about 1200 yards' elevation at the equator. The same reasoning applies to all other plants, with the exceptions arising from warm valleys, moisture of air, and richness of soil; and, as the engraving exhibits several hundred plants, it may be regarded as a philosophical map of the vegetable world.

The mountain may be considered as divided into ten regions, as follows:

1. Region of Lichens and Umbiliferia, from 15,500 to 17,000 feet.
2. Region of Grasses, from 13,500 to 15,500 feet.
   The highest limit of arborescent plants.
3. Region of Gentian, from 7000 to 13,500 feet.
4. Region of Wintera and Escallonia.
   Superior limit of the Cinchona, or bark-tree.
5. Region of Barnadesia and Duranta Ellisia.
   Highest limit of large trees, and the Mimosa.
6. Region of the Cinchona, from 3000 to 10,000 feet.
7. Region of the Date, Palm, and fine Gum Tree, from 6000 to 10,000 feet.
8. Region of Ferns and Trees, from 1500 to 5000 feet.
9. Region of Palms, from 0 to 3,500 feet.
   Inferior limit of the Cinchona.
10. Region of Subterraneous Plants.

THE BRAZILIAN FOREST.

We are indebted for this accurate representation of a tropical forest to Prince Maximilian. These forests do not consist, as in Europe, of separated trees intermingled with underwood; but Nature is here so luxuriant, that these eternal forests consist of solid masses of the largest trees, which can only be penetrated by cutting paths through them with immense labour. The trees consist of gigantic mangoes, palms, bignonia, the cocoa-palm, and other forest trees of colossal magnitude; and, where any space interposes, it is filled up with creeping plants, which render the whole a solin mass. The prince remarks that no European can form any conception of their grandeur, and that it is impossible to give an adequate description of them. Being thus inaccessible to the great enemy of the animated creation, every species of birds and variety of insects and creeping things live in undisturbed security. As an embellishment of the engraving, a party of persecuted Indians called Puris, to whom the woods also afford security in common with lower animals, are represented in one of their family peregrinations.

THE LINNÆAN SYSTEM DISPLAYED.

This plate represents twenty-four classes of plants according to the system of Linnæus, and, as the names of the several classes are expressed on the plate, no verbal description is necessary.

The ancients gave popular names to plants, founded on imaginary qualities, and affixed adjectives to distinguish varieties of the same kind; but, as these names were not connected with the substantive character of the plants, they served no purpose of identification, and hence Botany made little or no progress. To obviate this difficulty, botanists adopted various modes of classification, founded on external appearance, and not, as at first, on imaginary qualities. At length it was discovered, about the eighteenth century, that the parts of fructification were always permanent in the same plant. This natural character was therefore ingeniously seized on by Linnæus, as a means of disseminating and fixing the classes and orders of all plants, while other parts determined the genera, and differences of leaves the species. An inspection of the plate will illustrate the principle of Linnæus, as far as regards the classes and orders; and, with the aid of a microscope or magnifying glass, any person may extend these illustrations by observations in his own garden.

MRS. IBBETSON'S MICROSCOPICAL OBSERVATIONS ON THE STRUCTURE OF PLANTS.

Plate I.

Division 1. Dissection of an *Elm Leaf.*

Fig. 1. First cuticle.
—— 2. Third cuticle, the second being impervious.
—— 3. The veins of the leaf, containing the spiral wire, or muscles.
—— 4. The pabulum of the leaf.
—— 5. The under cuticle, with the bubbles.
—— 6. A section of the leaf shown in thickness, with its successive parts one above the other.

Division 2. Dissection of an *herbaccous Plant.*

Fig. 7. First cuticle.
—— 8. Third cuticle, the second being impervious.
—— 9. The pabulum.
—— 10. The veins of the leaf, containing the spiral wire, or muscles.
—— 11. Section of the leaf in thickness.
—— 12. The same leaf shrivelled.

Division 3. Dissection of a *young Grass Leaf shrivelled.*

Fig. 13. First cuticle.
—— 14. Third cuticle.
—— 15. Pabulum.
—— 16. Thickness of the leaf. The leaves of the crocus,

snowdrop, &c. have a glutinous liquor in their pabulum, which protects them from early frosts, with three cuticles above, and three below.

Division 4. Dissection of a *Leaf of an Evergreen.*

Fig. 17. First cuticle; whose shining appearance is caused by glutinous matter, which fills up the net-work of the exterior, and renders it lucid.

—— 18. Third cuticle: there are five upper and three under cuticles; and, in scented leaves, the second cuticle contains bladders of an oily compound.

—— 19. Pabulum.

—— 20. Veins and spirals.

—— 21. Sections of the leaf in thickness.

Fig. 22. The upper cuticle of a *Rock Plant;* this plant has not any impervious cuticle, but has millions of mouths in every leaf to receive moisture.

—— 23. The swellings in the upper cuticle of a rock plant.

—— 24. The holes or apertures which open into the swellings.

—— 25. One of the hairs on the leaf of a rock plant, showing its connexion with the three cuticles, through which it pierces to the pabulum. Young leaves have more hairs than old ones, but all are loaded with hairs, and often covered with a sort of net.

—— 26. Represents the edge of a young leaf, with its projecting hairs to increase the collection of moisture.

—— 27. Represents the edge of an old leaf, containing great additional appendages for the purpose of collecting moisture.

—— 28. Represents the edge of a young leaf, with all its appendages of hairs, &c. highly magnified, and forming a most extraordinary spectacle.

Figs. 29 and 30. *The formation of Pollen in Dioecious Trees.* The pollen is always formed in the top root, AA*a*, (the anthers and filaments are not produced till formed by the buds at the top of the plant,) when the anthers begin to form in the male bud. Fig. 30, the entering of the pollen into them is most evident, (B,) as they are then so stuffed, and filled to bursting, as to form a curious moving specimen for many minutes. Then the filaments are formed, and shoot forth from the male bud, to carry the anthers and pollen into the air, where they swing for some hours. Thus they absorb a quantity of gas by their motion, and soon become ripe; and, when the pistil indicates readiness to complete the seed, by the swelling of the bubble of liquid at the summit, the pollen again leaves the anthers, and flies to that nectarious drop, which attracts it to the pistil, remains fastened to the hairs to which the balls adhere; and are soon dissolved by the juices of the pistil, down which it runs in various gutters, till it has reached the seeds, which it enters mixed with the juice, and thus fructifies them.

The balls of the pollen are generally large, and run up the pith in different short vessels. Fig. 29, AA*a*, are all the same in their flowering; two stamens alone appear out of the bud; the others pass from the male bud to the female, and fructify all the seed. 4, is the nectary of the male bud of the willow; 3* of the female. The male is red up the spiral wire, the female by the alburnum; and so invariable is this law, that it passes through every class of plants.

Fig. 31 represents the stem of the tree, with the pollen ascending.

Fig. 32. *The Root of the Anther.* The threads which shoot from the anther after that it is filled with pollen, must be perfectly hollow the whole way; for so entirely does every ingredient, every nutriment, proceed from the root, that all must have free access to that part which appertains to it, and is intended to rise to the flower and the pistil. The anthers are little bags of exquisite workmanship, each sack divided into two or four partitions, always well filled by the pollen. They are highly curious, and the more they are magnified the more beautiful they appear.

Fig. 33. *Oblong Pollen.* The pollen, though it appears small, is not so in dioecious trees; and, though they seem like balls, yet, examined by the microscope, they differ in shape, some round, some square, triangular, oblong; and are equally various in colour, white, purple, blue, and red; but most pollen belonging to the same genera have the same form and shape,—an easy way of discovering the class of the flower. They have invariably two separate parts, and two different liquids: the outward part, as in fig. 33, is formed of a slight cuticle, sometimes crossed, or with circular apertures, which show the dark parts within, and which often exhibit vessels shooting from the exterior ball, and ejecting oil.

Figs. 34 and 35 represent views of the *Single Anemone*, to show how those sprigs found scattered in every part of the interior of the plant are also to be discovered in the corolla: in some they may be seen through the light, with a double microscope; in others, it is only by stripping off the upper cuticle. The cylinder to which the stamens are fastened passes between the numerous pistils and corollas: this shows that each ingredient, stamens, pistils, and corollas, have the same sort of cylinder in all flowers; but in the compound the cylinders pass, as in this, as low as *a, a, a,* where the mechanism *b, b,* is discovered in the plant, and where the different ingredients ascend.

Fig. 36, is a section of the same flower, but cut crossways.

Fig. 37, shows the instrument, or hair-like figure, in the *Sweet-Pea.* Hairs are not designed for absorption only, or one sort or form would have sufficed; whereas each vegetable has many different shaped figures, with valves and various species of curious mechanism. The sorts in the sweet-pea are, two in the *œnothera;* three in the *white antirrhinum;* three in the *lamium album;* and also one, admirable for its mechanism, nearly the same as in the nettle, but without its poisonous juices. The hairs change the colour of their juices, after entering a vapour, or sort of cloud, which becomes secreted between the valves; they afterwards admit another juice, and these coming in contact mix, explode, and produce the alteration required.

Figs. 38 and 39. Section of the leaf of the *Water Lily.* The first kind swim on the water. A double layer of air-vessels, and covered by an impervious skin, forms its surface in contact with the water; whilst the upper surface has a treble net, covered by a double skin, also impervious. The other leaf, fig. 39, is very different: when the corolla has fallen, and the seeds have dropped, the pericarpium decays, and a new germ, to contain the next year's fruit and flower, peeps above the mud, wholly covered with water, surrounded with very peculiar leaves, scalloped at the edges: they press the bud in every other part; the apex of the midrib just keeps above the water, by a large air-bubble, and by being full of air-vessels. There are none under the leaf, and few in the leaf-stalk; but the large opening for air between the skins of the leaf, at the top scallop, keeps it constantly upright.

PLATE II.

Figs. 1 and 2 represent the *buds of the Alburnum,* as cut down with a sharp knife longitudinally, after a fortnight's formation of the bud. It exhibits a most beautiful representation of the nascent flowers, which are all arranged in regular order, previously to their bursting forth in bouquets, baskets, cornucopia, &c.

Fig. 3 is the perpendicular section of the same young tree: *a, a,* are parts whence flower-buds may flow through the wood, preceded by a juice; *e, e,* is the pith, the line of life being on each side; from which line flow the flower-buds, *d, d.*

Fig. 4 represents a horizontal section of a young tree, with buds, both old and young, running from the centre to the circumference, *a* to *b*.

Fig. 5 discloses the formation of *flower-buds* at the exterior of the wood, as at *d*, *d*, of the natural size.

Fig. 6 represents the same young buds highly magnified, which have not yet reached, but are approaching, the bark at *b*, *b*. At *a*, *a*, the aperture for the bud is seen to pierce the whole way to the line of life next the pith.

Fig. 7 represents a perpendicular section of the *common Furze*, when the buds are passing up the wood at *a*, *a*.

Fig. 8. This beautiful exemplification of *the progress of Germination* shows the manner in which the seed is filled up by the atmosphere, and afterwards by the earth. The atmospheric juices fill the bag more than one-third before the vessels from the root operate through the pith; the heart, *a*, enters the bag of the seed, and, as soon as it is fastened, a wonderful mechanism takes place to appropriate the atmospheric nutriment, which is effected by a feather arising from the stigma: the pollen spreads all over this feather, and, dissolving in the juice, it there encounters and runs down the feather, to impregnate the seed. This feather consists of a most extraordinary mechanism of small vessels, like pitchers, fixed along its branches, as is represented more at large in fig. 9; and the construction of which cannot fail to excite the highest admiration. When the impregnation is completed, the feather cleanses itself from the pollen, and the pitchers are empty to receive the atmospheric moisture, by which the bag of the seed is filled; the hairs, *b*, *b*, contribute at the same time to the same purpose, both supplying nutriment to the bag, *c*, *c*; but the liquid from the feather is thicker than that secreted by the hairs. This beautiful apparatus then decays, and the nutriment from the earth rises through *d*, *d*, *d*.—The first process appears to resemble the temporary sustenance of the fœtus of an animal.

Fig. 10. These represent a specimen of the *Gourd* cut horizontally, showing the different seed-vessels half filled by the atmosphere, and beginning to receive nourishment from the earth. The process is the same as in wheat: the vessels, *f*, *f*, contain the heart of the seed, *a*, *a*; and the powder nutriment is shown at *g*, *g*, *g*, pouring into the bottom seed-bag.

Formation of the Seed in its regular Progress.

Fig. 11. Natural size of the radicle.

—— 12. The same magnified.

—— 13. The vessels running through the root centered in the alburnum vessels, and proceeding up to the different buds, but not entering them; the buds are then seen to forsake them, and to pass up into the new shoot, just formed, by stalks growing under each bud, as in fig. 14; and then running up to their proper places in the new shoot.

Figs. 15 and 16. These represent the new shoot, round which the buds have arranged themselves; and the vessels formed to convey the balls from bud to bud, dropping so many at each pericarp, which then closes on them; while the collection from which they run at L, L, decreases hourly, till it is all exhausted. The seeds may be seen for the next hour to move into the different pericarps up the stem of the flower, at fig. 16, drawn in by the line of life at O, O, O; then those balls become fructified which had moved from the root upwards, and the embryo grows in the ball.

Fig. 17. The seed, with its heart reaching from Z to W.

Figs. 18 and 19 disclose the manner in which the sap-vessels appear when the specimens are cut horizontally and perpendicularly; the hollow of the vacancies in which the sap runs at B, B, B; and the manner the spiral is carried round at D, D, D.

PLATE III.

Fig. 1. *Fresh-grown Radicle of the Iris.*

When the seed is first formed in the extremity of the radicle, it soon (from powder) changes to balls, tied together by a line of life: the collecting of this powder, and the action of the line, is probably the first cause of its aggregating. The flowers then, which had spread from the first old seed, run down into the thread roots, and enter the radicle just where it is fastened to the root; and there each heart of the seed takes in its germ and female. A A, a fresh-grown radicle of the iris, where the powder first forms into seeds, of a pink colour, and easily distinguished. BB, where the powder forms into balls, still coloured. CC, where the female or flower first enters the radicle from the root and old seed, and, breaking off into shoots or separate germs, are drawn within the seeds. DD, a part where the pollen appears collected. The ball, when first formed at AA, consists of the heart of the seed only, an empty bladder, with a shoot below it: the vacuum is the part of the corculum first filled up, when the heart is fructified and brought from the root. When the seed is once fixed in the earth, it serves as a basis for the stripes of flowers in the wood, and as a commencement of those which entered the radicle. But, when the new-formed seeds are thus finished, they rise from the root, and pass through the alburnum; then the flowers of the preceding year enter the flower-bud. The festoons and bouquets are alone forward enough to complete themselves, and rise up by the simple growth of their several peduncles, and burst into light and beauty. No tree, therefore, could flower the first year; and, in annual and herbaceous plants, seasons must stand in lieu of years.

DD has the appearance of pullen between the seeds, exactly like that which shows itself in the alburnum.

Fig. 2. The seed of the *Melon* just after fructification.

—— 3. A diminutive specimen of the part of the *Bean* surrounding the embryo.

Fig. 4. The seed of the *Buck-wheat*, and the embryo spreading around.

Fig. 5. The interior of a *Pea* before fructification.

—- 6. Specimens of the *heart of the Fir-seed*, now round, though afterwards a long oval, taken while in the root, before they enter the alburnum. They may be compared with the seed when it is first discovered in the seed-vessel, and afford proof that it was the seed in the root, since the same shoot may be discovered in both.

Fig. 7. *Heart of the Seed of the Fir* when divided, throwing out its germ or flower.

All these have the same regular process. The heart of the seed mounts with its germ from the root into the seed-vessel, and proves itself the seed, not only by its whole progress to fructification, but by having the same germ in the heart which it afterwards displays in the fructification: and thus not only the embryo, but the female flower, is also fitted for its increase, and fixes, by the various germs in the seed, the beginning stripe for each line in the wood. The flower, therefore, is continued from plant to plant, while the male is renewed and reproduced yearly in every tree.

FOURTEEN REPRESENTATIONS OF PRINCIPAL VARIETIES OF BRITISH FOREST TREES.

It may be proper to explain that these trees have been copied from a series of remarkable engravings published a few years since by an ingenious artist of the name of Coussens, and which have for some years been very scarce. They pourtray in the most effective manner the vertical section or physiognomy of the whole tree, and convey more accurate notions than if an attempt had been made to delineate the several leaves, in the usual manner; because in the present size, however laboured might have been the engraving, an accurate discrimination of the forms of the leaves could not have been made.

THE DATE TREE.

The method of cultivating this useful tree in Barbary, and the different uses to which it is applied, are thus described by Desfontaines: “All that part of the Sahara which is near Mount Atlas, and the only part of this vast desert which is inhabited, produces very little corn. The date-tree, however, supplies the deficiency of the corn, and furnishes subsistence. Forests of them may be seen here and there, some of which are several leagues in circumference. All these forests are intermingled with orange, almond, pomegranate, and especially vine trees; which last twist round the trunks of the dates, and thus ripen their fruits by the heat of the climate, though they are never exposed to the sun. But it is not the fruit alone which renders the date so precious among the inhabitants of the East; since there is scarcely any part of the tree which is not useful. The wood, though of a spongy texture, lasts such a number of years, that the inhabitants of the country say it is incorruptible. The substance which is found in the centre of the young date-trees is very nourishing, and has a sweet taste. The Arabs, who strip the bark and fibrous part off the tree, in order to obtain this food, call it the marrow of the date.

THE ALOE IN BLOSSOM.

As aloes seldom flower in our climate, an aloe in blossom is a curiosity; but it is a vulgar error that it blows but once in a hundred years, for in warm climates they flower much more frequently; but it is not merely the rarity which renders the blowing of an aloe an object of interest, for at that time it is one of the most elegant and stately objects in nature. The species in question is not the same as the medicinal aloe, which grows in eastern countries; whereas the aloe represented is a native of America.

THE COCOA NUT.

This famous tree flourishes in Asia, Africa, and America: it grows straight to the height of sixty feet, and there presents a bunch of ten or twelve leaves three or four yards long. Under the bunch of leaves issues a sheath, from which grows a panicle covered with yellow flowers, yielding cocoa-nuts. These, as is well known, afford food, oil, and milk. It produces fruit three or four times in the year; and, if the sheath be cut off, sweet and agreeable flavoured liquor flows from the wound, called toddy, a cooling liquor, but which after fermentation becomes intoxicating. Every part of this tree is rendered useful: it makes cloth, ropes, timber, and roofs for the houses. The cocoa-nut is the principal ornament of tropical scenery; but in America it is eclipsed in size by the less useful cabbage-tree, which grows to triple its height, and is the sovereign of the forest.

THE PALM TREE.

The Palm tribe are the glory of the forest. The species represented is called the Borassus, or Fan-leaved Palm; and flourishes throughout India, growing to the height of thirty feet. It surpasses other vegetables in the various uses to which it is applied: it furnishes articles of the most dissimilar nature—wine, oil, wax, flour, sugar, and salt. It generally blossoms in January and February, though some flower at other seasons: its fecundity is astonishing, not only in umbrageous foliage, with which men thatch their houses, but also in the multitude of its flowers and fruit. The leaves, produced every spring, originate always from the summit, the older ones standing below, the others gradually drying up, and leaving circular impressions, which mark the age of the tree. A considerable part of the inhabitants of Egypt, Arabia, and Persia, subsist almost entirely upon its fruit. Their camels feed upon the date-stones, while from the leaves they make couches, baskets, bags, mats, and brushes; from the branches, cages for their poultry and fences for their gardens; from the fibres of the boughs, thread, ropes, and rigging; and from the sap a spirituous liquor.

A beautiful species of this tribe grows in the West Indies, and with the leaves the houses are thatched; and these leaves, before they are expanded, are cut and made into women's plaited hats, and the berries are used for buttons.

THE LEMON TREE

Has an upright smooth trunk, divided upward into a branchy regular head, from twelve to fifteen feet high; large, oval, spear-shaped, pointed, slightly sawed leaves; and many flowers from the sides of the branches, succeeded by oval fruit, prominent at the top.

ORANGE TREE.

The orange, like the lemon, is of the genus *citrus*, of the order *polydelphia*, and classed *icosandria*. It is a dwarf, running in its different varieties from three to twelve feet high; and of such longevity, that some of those which grow in the gardens of the Tuileries at Paris were brought there in the time of Francis the First. In warm climates, where they flourish, there are as many varieties as of our common fruit-trees: the chief are the Seville, which produces an acid fruit; and the others, or sweet-fruited kinds, are the China, the great Shaddock, the Forbidden-fruit, the horned Orange, the Hermaphrodite, and the Dwarf.

SUGAR CANES.

There are three species of sugar-cane, which may be distinguished by the colour of the leaves; namely, the ancient Creole sugar-cane, the Otaheite cane, and the Batavia cane. The first has a leaf a deeper green, the stem less thick, and the knots nearer together.

The second is of a lighter green; and its stem is higher, thicker, and more succulent. The whole plant displays a more luxuriant vegetation.

The third species, the violet sugar-cane, called Cana de Batavia, is indigenous in the island of Java. Its foliage is purple, and it is preferred in Caracas for rum.

We have given two species,—the East India, or Batavian, with violet bark; and the common West India cane, both drawn after nature, and never before published.

COFFEE TREE.

The coffee, like the tea, tree is celebrated among all civilized nations for the refreshing drink made from its berries. It acquired its fame in Ethiopia, and is still cultivated and prepared in Arabia in the most delicate manner. It was afterwards transplanted to the West Indies, where it has become an article of immense commerce; but, from not being prepared with the same care as in Arabia, is much less esteemed than that which is brought from Arabia and the Levant. The specimen in the engraving represents a branch of the tree with its berries and flowers. The figure *a* represents the flower in detail; *b* the parts of fructification; *c* the entire berry; *d* its interior; *e* the kernel, with part of the rind taken off; *f*, *g*, and *h*, parts of the kernel. The natural height of the tree is from fifteen to eighteen feet; and, if left to itself, it would have the form of most other trees, i. e. a naked trunk and a branchy head. This is prevented by the top of the tree being cut off when it has arrived at its desired height.

TEA TREE.

This specimen will be viewed with interest, as its leaves furnish our most common beverage. It is little creditable to the policy of Europeans, that its cultivation was confined to certain provinces of China till after the commencement of the present century. Since that time, the Portuguese, with laudable spirit, have transported numerous plants to the Brazils, and with the aid of some native Chinese have cultivated it with considerable success; but not in sufficient quantities to render it an article of commerce. The plant grows five or six feet high, and sometimes ten or twelve. The leaves are about an inch and a half long, narrow, indented, and tapering to a point, like those of the sweet-brier, and of a dark green colour. The root is like that of the peach-tree, and its flowers resemble those of the white rose. The stem spreads into many irregular branches; the wood is hard, of a whitish green colour, and the bark is green, with a bitter, nauseous, and astringent taste. The fruit is small, and contains several round blackish seeds, about the size of a bean: the plant is propagated by these seeds, which, being planted, grow without any care. The finest tea-plant known in England was raised in Kew Gardens; but the first that ever flourished in Europe belonged to the Duke of Northumberland, at Sion-House, from a drawing of which the engraving is copied.

The use of tea was first introduced into England in the reign of Charles II. and is now so general, that upwards of 25,000,000lbs. are annually consumed in the British dominions.

TOBACCO.

The two varieties of this plant, cultivated for common use, are distinguished by the names of Oronokoo and sweet-scented Tobacco; the leaves of the former being larger and narrower than the latter. They are tall herbaceous plants, growing erect, with fine foliage, and rising with a strong stem four to six feet high. The leaves are of a deep green, and grow alternately at two or three inches distance: they are oblong, spear-shaped, oval, and simple; the largest about twenty inches long, but decreasing as they ascend. The stem and branches are terminated by large bunches of flowers, collected into clusters of a delicate red. It is cultivated with success in the Netherlands and other European countries; but has been discouraged in England by the colonial policy of the government.

COTTON TREE.

Commerce and manufactures have within the last fifty years rendered this the most important tree in the whole vegetable kingdom. There are several species. The common Levant cotton, which is cultivated in several islands of the Archipelago, in six months becomes as large as an European quince. In China is cultivated that particular species which produces the cloth usually called nankeens in Europe. The Barbadoes Cotton-tree, with a stem from six to fifteen feet in height, is the species which is so much cultivated in the West Indies, and forms the chief branch of their exports. All the species of cotton are very tender, and will not grow in the open air in England. It is propagated in the West Indies, by seed, which is set in rows, about five feet asunder. The Indians use the leaves for cooling and healing wounds; the tree bears rich sulphur-coloured flowers, which are very large and beautiful. After the flowers, a head of seed follows, which, when it comes to maturity, bursts open, scatters the seeds, and discovers the white cotton.

FIG TREE.

This tree, now so well known in our English gardens, produces the figs of commerce on the shores and in the islands of the Mediterranean. It is little creditable to the horticulturist of France and England that it has not been more generally cultivated in both countries, as a single tree at a village near Worthing has for many years yielded its owner upwards of £25 per annum in the sale of its fruit. The first fig-trees introduced into England are those in the archbishop's garden at Lambeth. These trees are of the white Marseilles kind, and still bear delicious fruit. They are said to have been planted by Cardinal Pole, in the reign of Henry VIII. At Mitcham, is likewise a specimen of the same kind, which is asserted to have been planted by Cranmer. In a garden at Winchester, there was, in 1757, a fig-tree, whose fruit was of the small red sort; and on the stone wall to which the tree was nailed, was an inscription denoting that James I. partook of the fruit in 1623. At Oxford is a fig-tree, planted by Dr. Pocock in 1648. The trunk is perforated by insects, and much damaged, but the branches make vigorous shoots, and produce a great number of figs.

THE BANIAN TREE.

The Banian, or Bhurr-tree, is considered as one of the most curious and beautiful of Nature's productions in the genial climate of India. Each tree is in itself a grove, and some of them are of an amazing size, as they are continually increasing; and, contrary to most other animal and vegetable productions, seem to be exempted from decay; for every branch from the main body throws out its own roots, at first in small tender fibres, several yards from the ground, which continually grow thicker, until, by a gradual descent, they reach the surface; where, striking into the ground, they increase to a large trunk, and become a parent tree, throwing out new branches from the top. These in time suspend their roots, and, receiving nourishment from the earth, swell into trunks, which shoot forth other branches: thus continuing in a state of progression so long as the first parent of them all supplies her sustenance. A banian-tree with many trunks forms the most beautiful walks, vistas, and cool recesses, that can be imagined. The leaves are large, soft, and of a lively green; the fruit is a small fig, when ripe of a bright scarlet.

THE CLOVE-TREE.

The Clove-tree rises to the height of a common apple-tree; the leaves are like those of the bay-tree; the flowers are produced in loose bunches at the ends of the branches; are small, white, and have a great number of stamens, which are much longer than the petals. The flowers are succeeded by oval berries, which are crowned with the calyx, divided into four parts, and spreading flat on the top of the fruit. The young fruit, beaten from the trees before they are half grown, are the cloves used in Europe.

THE NUTMEG-TREE.

Fig. *a*, represents a sprig, with fructification. The drupa of the natural size, and bursting open.

Fig. *b*, the full-grown fruit cut lengthwise.

Fig. *c*, another section of the same.

Fig. *d*, the nutmeg enveloped with its covering, the mace.

Fig. *e*, the fatty membrane, or mace spread out.

Fig. *f*, the nutmeg of its natural size.

Fig. *g*, the same with its external tegument removed at one end.

Fig. *h*, The same with its outer tegument entirely removed.

Fig. *i*, a transverse section of the entire nutmeg.

Nutmegs flourish in a small group of islands in the Eastern Archipelago, known by the names of Banda, Terrate, and Amboyna; but, when these islands lately were held by the English, they conveyed plants to several English settlements, where they succeed. The tree grows thirty feet high, producing numerous branches; and there are three varieties,—the Male, or barren; the Royal; and the Queen. The royal produces the largest nut. The internal rind affords the delicate spice called mace; and such is the high price of these productions, that this tree may be considered the most valuable that grows. The internal fruit is about the size of a peach, and consists of the external covering, which is smooth, fleshy, and bitter. When the fruit ripens, this bursts, and discloses the mace; and within the mace is enclosed the nut. The fruit is gathered three times a-year; and, when the mace and nut have been dried in the sun, the nutmeg is steeped in lime-water and the mace in salt-water, to protect them from insects.

THE CINNAMON.

The *cinnamon* is a species of the *laurus*, of the *monogynia* order, and the *enneandria* class, and a native of Ceylon. It grows twenty or thirty feet high, and its bark at first is green, and afterwards red. The well-known spice is the under bark. This is separated in the spring, cut into thin slices, and on exposure to the sun curls up in drying. Trees about three or four years old yield in perfection. The trunk, when stripped, dies ; but the root continues to throw up fresh shoots. The seed of this tree, when boiled, yields an oil, which swims at the top, and, when left to cool, hardens, and serves to make aromatic candles.

PIMENTO, OR JAMAICA PEPPER.

This plant is indigenous in Jamaica, and all attempts to propagate it, either by young plants or from seed, have proved abortive,—it must grow spontaneously. Soon after the trees are in blossom, the berries are fit to gather, the fruit not being suffered to ripen on the trees, as the pulp, being moist and glutinous, is difficult to cure, and, when dry, becomes black and tasteless.

THE BREAD-FRUIT TREE.

The Bread-fruit Tree is the size of a middling oak : its oblong leaves are frequently eighteen inches long, deeply situated, and like those of the fig-tree in colour. The fruit is the size and shape of a child's head; and the surface reticulative, not unlike a truffle; it is covered with a thin skin, and has a core as large as the handle of a small knife. The eatable part lies between the skin and the core, is as white as snow, and of the consistence of new bread; it is divided into three or four parts, and roasted before it is eaten : its taste is insipid, with a slight sweetness resembling that of the crumb of wheaten bread, mixed with a Jerusalem artichoke. It has been transported from the islands of the Pacific to the West Indies, but is not fancied.

THE PLANTAIN-TREE

Is cultivated in all the islands of the West Indies, where the fruit serves the Indians for bread. It rises with a soft stalk, fifteen or twenty feet high. The leaves are often eight feet long, and from two to eight feet broad. The flowers blow in bunches, each of which is covered with a sheath of a fine purple colour, which drops off when the flowers open. The fruit, or plantains, are about a foot long, and from one to two inches in diameter: it is at first green, but, when ripe, of a pale yellow colour. The skin is tough; and within is a soft pulp, of a luscious sweet flavour. The spikes of fruit are often so large as to weigh upwards of forty pounds.

THE BANANA

Differs from the plantain in having its stalks marked with dark purple stripes or spots. The fruit is shorter, straighter, and rounder: the pulp is softer, and of a more luscious taste. The fruit of the banana is four or five inches long, of the shape and size of a cucumber; the leaves are two yards long, and a foot broad in the middle; they join to the top of the body of the tree, and frequently contain in their cavities a great quantity of water, which runs out, upon a small incision being made in the tree, at the junction of the leaves. This tree is perennial, and dies to the ground every autumn. As the fruit, when cut transversely, exhibits the figure of a cross, it is considered as forbidden by many superstitious Catholics.

THE MANGROVE.

This tree forms impenetrable forests on the banks of the rivers of Africa, and in many parts of Asia, chiefly near the sea,—the salt-water tide being apparently necessary to its duration. It is covered with extended branches and with large shining leaves. Like the banian-tree, it sends down shoots, which take root and form so many stems as to be impenetrable. The seed of this tree actually germinates before it falls from the tree, and the radical grows in that state a foot long; and, the heavy part of the seed being on the opposite side of the radical, they always fall so as to stand erect. Oysters attach themselves to the roots, so that when the tide retreats oysters may be gathered like fruit from the branches of the roots, two or three yards high; a circumstance which has given rise to many marvellous relations.

THE RHUBARB.

This plant, whose root is so salutary to the human stomach, grows in several varieties, one of which is known to our English gardens, and yields us excellent spring pies for the table; and the root, properly prepared, is said to be of excellent medicinal quality; but the rhubarb of the shops is the Tartarian species, which grows with a stem six feet high. In Montgalia, the Tartars dig up the roots, and cut the large ones into pieces, to dry them more readily; while in the middle of each they scoop a hole, through which they pass a cord, to suspend them in their tents, or about the horns of their sheep, to dry.

PAPYRUS.

This beautiful engraving exhibits several specimens of the papyrus plant as it grows in marshy situations on or near the Nile. It is an object of curiosity, as having furnished the paper on which the ancients wrote; but is no longer useful for that purpose, as more perfect materials have presented themselves in the fibres of various plants, which are successfully manufactured into paper for every variety of purpose.

THE SENSITIVE PLANT, OR MIMOSA,

Is famous for the sensibility of its leaves, supposed to be a mechanical affection, and not to arise from nervous irritability conveyed to a censorium, as in animals.

THE BENZOIN, OR BENJAMIN TREE,

Is a native of Sumatra, where it furnishes the well-known balsam, which it exudes on being wounded, and which is of great importance in the Materia Medica for many purposes.

BRITISH GRASSES.

The reader is here presented with representations of sixteen of the principal grasses which adorn our fields, feed our cattle, and ultimately those who feed on them. We say principal grasses, because, little as it may be suspected by the cursory examiner of nature, nearly one hundred several varieties of grasses contribute to the verdure of these fortunate islands.

VINE LEAF MAGNIFIED.

This figure exemplifies the beautiful structure of leaves in general, as seen through high magnifiers. The circulations are made through the fibres and vessels which cover every part; and in general small insects may be seen roaming in the divisions like cattle grazing in enclosed fields, various leaves supporting different species of insects; and the same leaf, different species at different times and ages.

FLAX.

This is one of the most useful plants cultivated by man. It is a source of great wealth to the people of Ireland and the Netherlands. In the latter country it surrounds every cottage, and is a neat, clean, and elegant production. The cottager sows it, rears it, and prepares it, through all its stages, so as to fabricate from his own growth the linen used in his family, and even the fine laces with which Flanders supplies the rest of Europe. The species of *Linum* that is here figured is the only one that is used for the purpose of making flax in all nations: but varieties of this species, arising from culture and soil, are so different as to make the manufactures appear as though it were the produce of a different plant. The flax, for instance, which is sometimes imported from France is of so fine a texture as to resemble silk; while it would be in vain to attempt to make the fine lace of Flanders from any flax grown in England. The flax-plant grows about thirty inches high; but hemp, which furnishes a coarser fibre, grows from six or nine feet high, and should not be confounded with flax.

THE BETEL TREE.

This is one of the noble Palm tribe, and grows to the height of thirty feet, being a great ornament of eastern gardens. It produces a fruit in universal use in the east, of the size of a large walnut, with a kernel as big as a nutmeg. The natives chew it, mixed with the leaves of a pepper-tree, as the Europeans do tobacco, but more universally. The wood is used for a great variety of purposes.

SAFFRON CROCUS.

The stigmata of this plant yields the saffron of the shops, so useful in the materia medica as an aromatic cordial. It exhilarates the spirits, and is much used in hysteric affections. Spanish saffron is the most esteemed; but large quantities are cultivated in the unenclosed parts of Cambridgeshire. The flowers are gathered in the morning, carried in baskets, the stigmata or chives picked out, and the rest of the flower thrown away. These are then kiln-dried, and, as each acre produces three crops or pickings, the quantity of marketable saffron from an acre is considerable.

EUPHORBIA, OR SPURGE.

These are milky plants, the juice of which is so acrid that it corrodes and ulcerates any part of the body which it touches, and is therefore used to eat away warts and corns and the nerve in decayed teeth. It is also used by the Hottentots to poison their arrows, and sometimes to poison fountains of water at which wild beasts drink. One species produces a gum, by making incisions in the plant, and this also is poisonous.

THE COCCUS CACTI, OR COCHINEAL INSECT.

This insect is famous for the red dye which it communicates to wool and silk. The females yield the best colour, and are in number to the males as three hundred to one. They live on the plant represented in the plate called in New Spain Nopal or the Indian fig-tree. The magnitude of the insect is that of the tick found in dogs and other animals. The plants are cultivated for the sake of the insects. In May or June it is in perfection, and then the eggs are deposited among the leaves. In two months it grows to its full size, but is liable in its infant state to a variety of casualties, besides having enemies in birds and worms. The barbarous method is then adopted of gathering the insects into earthen pots, and killing them by millions, without compunction, either by pouring hot water on them, by exposing them to fire, or to the rays of the sun. There are few persons who, if they were themselves called upon to perform this operation, would not rather dispense with scarlet colours. These practices are chiefly carried on in New Spain and in the north of Peru, where they form the chief employment of many Indian tribes.

COMPARATIVE ANATOMY.

In these plates are represented the sculls of fifteen varieties of animals, from the European to the dolphin. The capaciousness of the scull and brain of the European will be palpable; while the declining form of that of the African and Ourang Outang affords evidence of their declining intellect. The elephant affords the next evidence of capacity of brain, while in that organ, so essential to the reasoning powers, the other animals appear to be very deficient.

The *skeleton of a cat* will enable the reader to compare the frame work of this animal with that of man.

PHYSIOGNOMY OF BIRDS AND QUADRUPEDS COMPARED.

The four subjects given have been taken at random, as indicative of similarity of structure, and, probably, of character. The subject might be even followed with great amusement through the entire tribes. In this plate are also introduced the legs or hinder paws of nine varieties of animals. The comparison of them, with reference to elegance of form, strength, and facility of motion, will afford an amusing contemplation.

CAUSES OF PHENOMENA.

As the consideration of Nature leads to enquiries into Causation, this work would be incomplete without some notice of the general causes of the wonderful phenomena which have been described in it.

It should be borne in mind, that, whenever we speak of phenomena, we mean such appearances and changes as are perceptible by our senses; and, as these have cognizance only of matter, so all phenomena with which we are acquainted through our senses relate to matter only, and are material. In examining material phenomena, or the accidents and changes of matter, as far as they are brought about by secondary causes, we must therefore search for such secondary causes in simultaneous operations of other matter sufficient to produce the effects.

Philosophers in general have taken a short road to this knowledge, by ascribing almost as many independent powers to matter as there appear various phenomena; but, as it must be evident, on the slightest consideration, that, as matter itself is essentially inert and passive, it cannot possess any original or innate powers of self-operation; such as an attractive power, a repulsive power, a calorific power, a sucking power, a sympathetic power, or any active power whatever. Power appears in matter only when in motion, and while moving; and then only has the capability of moving other matter, and producing material phenomena.

Action and reaction, too, are equal; that is, the motion imparted to one body must, before it returns to a state of rest, be received by some other body, or distributed to various bodies; or, by contact with other bodies, be again re-distributed by them; thereby producing constant successions of phenomena, and the well-known activity of Nature, in atoms and masses. Further, as action and reaction are equal, there must always be the same quantity of motion in the universe.

To ascribe powers of action to matter, and particularly the powers of attraction, which supposes that each body is acting on the contrary side of the other body, by pushing it towards itself in a place where it is not, is at once absurd and ridiculous. Yet this climax of error, admitted by Aristotle, Copernicus, Kepler, and others, in times when witchcraft, necromancy, luck, and astrology, were generally believed by mankind, still pervades all our books of science; and a generation must probably pass away before the powers called attractive, repulsive, and the like, are justly and correctly ascribed to the special motions and particular relations of other bodies, which produce all such appearances.

The two species of supposed attraction most observed are

(1) the fall of heavy bodies towards the centre of the earth, and (2) the approach of light bodies floating on water. But the first has recently been proved to arise from the two great motions of the earth, which combined motions necessarily precipitate every part towards the centre of the moving mass; and the second arises from the circumstance that each of the floating bodies intercepts the pressure of the atmosphere in its own direction, so that the external pressure is greater than the internal pressure. Terrestrial gravitation has, therefore, a local and not an universal origin, and planetary aggregation is in every case local. In like manner, all other attractions may be explained by local and special affections of the bodies.

Nor is this a question about terms, as many would insinuate, for false premises lead to false analogies. Thus, if the absurd and impossible principle of attraction, or a force drawing towards the sun, is believed, we then raise upon it a false theory of the motions of the heavenly bodies. We are forced to invent a whimsical projectile force to prevent the fall of the planets to the sun; and then, to preserve this projectile force unimpaired, we require the extinction of the gas which fills space, and which is the operative lever that unites all parts of the universe. As there is no attraction, or central force, so there is no need of any projectile power, nor of a vacuum in universal space.

It is not indifferent, in adopting even a true law of nature, whether we ascribe that law to a true or false mode of action; for the law may be true, and yet the mode of action be very different from that assumed; and hence a continued train of errors will result. In like manner, by ascribing heat to caloric, instead of atomic motion, we involve chemistry in labyrinths of explications and false analogies, which render nature ridiculous. If the basis is defective, the superstructure must either fall or become an object of derision, when examined in relation to other phenomena.

In a word, all power which affects sensible and material bodies arises from matter multiplied (so to speak) by motion or velocity; and, in seeking for the causes of phenomena or changes, we must examine what is passing among the atoms in contact, or among the nearest masses. Of course, as matter can never originate its own motion, motion itself must commence independently of matter; and we hence arrive at the knowledge of the necessary existence of the sublime, eternal, omnipotent, and omniscient Creator, Contriver, and Continuator of the Universe!

LECTURE LXXIII.

THE SCIENCE OF BOTANY.

Your contemplation further yet pursue:
The wond'rous world of vegetables view!
See various trees their various fruits produce,
Some for delightful taste, and some for use.
See sprouting plants enrich the plain and wood,
For physic some, and some designed for food.
See fragrant flowers, with different colours dyed,
On smiling meads unfold their gaudy pride.—BLACKMORE.

To discriminate the almost infinite variety of plants, by regular proper names, determined by some peculiarity in the plant, several systems have been invented, but those now in fashion are the sexual system of Linné, and the natural system of Jussieu.

The Linnæan system is founded on the number, situation, and proportion of the essential organs of fructification in the flower, denominated *stamens* and *pistils*. The vegetable world is, by this system, divided into twenty-four *classes*, distinguished by their *stamens*; these classes are subdivided into orders, which are generally marked by the number of the *pistils*.

The first ELEVEN *Classes* are distinguished solely by the number of *stamens*; and are called *Monandria*; *Diandria*; *Triandria*, &c. to *Dodecandria*, from Greek words; while the *Orders* are denominated *Monogynia*, *Digynia*, &c. to *Polygynia*, accordingly as the flower has one, two, or more pistils.

As an example, the Jessamine, being in the second class and first order of the class, is placed among the *Diandria Monogynia*, and has two stamens and one pistil; the Lily, having six stamens and one pistil, is named *Hexandria Monogynia*; but the Rheubarb is the only species of the *Enneandria Trigynia*, having nine stamens and three pistils. The stamens and pistils may be counted by the eye, but it is more usual to employ a small microscope.

The *fifth*, PENTANDRIA, is the most numerous of all the classes; the *sixth* contains the lilies, and many other bulbous plants, and is sometimes called the Liliaceous tribe.

The 12*th class*, ICOSANDRIA, has twenty stamens or more, inserted into or growing out of the calyx, and this mode of insertion always indicates eatable and wholesome fruit.

The 13*th class*, POLYANDRIA, has numerous stamens inserted into the receptacle; the plants of this class are often poisonous. The *14th class*, DIDYNAMIA, is known by two longer and two shorter stamens, and comprehends flowers similar in their structure to the fox-glove and dead-nettle. The TETRADYNAMIA, or *15th class*, has flowers containing four long and two short stamens; these comprise the cruciform flowers, as the stock-gilliflower, radishes, cresses, turnips, and cabbages. The class MONADELPHIA contains many plants similar to the mallow; they are known by the union of the stamens at their bases into a cylinder; there are eight orders in this class, of which the 8th,

POLYANDRIA, is the most important, and contains mucilaginous emollient plants.

The DIADELPHIA contains papilionaceous flowers, resembling a butterfly; as the pea, the kidney-bean, the broom, the furze, and the acacia.

The POLYADELPHIA has the filaments of its flowers united into several masses or bundles.

In the class GYNANDRIA, the stamens are inserted either upon the style or germen; there are nine orders in this class, among which is the Fly Orchis, a curious flower found chiefly in the chalky soils of Kent and Cambridgeshire; and the Ladies Slipper, which is a very scarce British plant.

The three classes, MONOECIA, DIOECIA, and POLYGAMIA, differ from the rest in having some flowers with filaments, and some with pistils only, either on the same plant, or on different plants, or mixed with flowers of the more common construction. Most of the forest-trees belong to these classes. In the MONOECIA is the bread-fruit tree, which serves for clothing as well as for food, the inner rind of the bark being manufactured into a kind of cloth; and likewise the sedge, the paper-mulberry, and common arrow-head. In the DIOECIA are the willow, the hop, the misseltoe, the hemp, and the yew. In the POLYGAMIA class the principal plant is the cultivated fig-tree.

In the last class, CRYPTOGAMIA, the stamens and pistils of the plants are either not well ascertained, or not to be numbered with certainty. This class includes the ferns, the mosses, the liverworts, the flags, and the fungi. Among the flags is the Rein-deer Lichen, upon which the numerous herds of rein-deer, the only wealth of the

Laplanders, are entirely dependant for their winter food. In that country it generally grows a foot high, covering the ground like grass.

The natural system, by Jussieu, divides the vegetable world into fifteen *classes*, and the *genera* into one hundred orders. The author of this method separates the cryptogamic plants from the others. The seeds of the *cryptogamic* plants, which form the *first* class, being without cotyledons or seed leaves, and all other plants being distinguished into such as have seeds with one and with two cotyledons. As the stamens are inserted below the pistil, on the calyx, or on the seed-vessel, the first description of seeds affords three distinct classes. The plants which have two cotyledons follow, and are divided, from distinctions in the flower-leaves, into those that are APETALOUS, without petals; MONOPETALOUS, with a single petal; and POLYPETALOUS, with many petals.

These are again subdivided according to the insertion of the stamens, and the union or separation of the *antheræ*, which they support, into ten classes; which, with the four already mentioned, make fourteen; to these the DECLINOUS plants, so called from the separation of the stamens and pistils, are to be added, which make his fifteen classes. These have no appropriate name, but are distinguished by numbers with a short definition of the essential character. The orders are, for the most part, named after some principal genus belonging to each.

Such are the systems of Linné and Jussieu: the application of each to unknown plants may be thus described. When we meet with one of unknown description, by the Linnæan method, we count its pistils, stamens, and styles, or observe any other circumstance attending those organs, on which the characters of the *classes* are founded. We then, by similar means, determine the *orders*, and afterwards proceed to compare the parts of its flower and fruit with the characters of every genus in that order, till we find one that agrees with them. Having fixed the *genus*, we read over the characters of the *species*, till we have met with the right.

The mode of using the system of Jussieu is to consider what known genus or family the plant most approaches in its habit and leading characters. By turning to such, through the help of an index, we know how far we are correct, and we may by this means become familiar with the natural orders and affinities.

Having determined the genus, we must recur to the Linnæan method for the species, because Jussieu has not treated of species

It may be proper, for the use of Students, to introduce a more detailed view of the System of LINNÆUS, particularly, as it is the prevailing system of the age in which we live, and, perhaps, is not capable of much improvement. But, it may be proper to premise, that mere reading is scarcely sufficient, and that some labour ought to be bestowed to fix the terms and classification in the mind.

A PLANT is a vegetable production, consisting of root, stem, leaves, props, and fructification, by which we understand flower and fruit. And plants are either Annual, Biennial, or Perennial.

ROOTS are, *Simple, Ramose, Bulbose, Tuberose, Articulate, Fusiform, Globose, Repent, Fibrose, Præmorse,* and *Radicula.*

STEMS are of seven kinds: *Caulis, Culmus, Scapus, Peduncle, Petiole, Frons,* and *Stipes.*

LEAVES are divided into *Simple, Determinate,* and *Compound.*

PROPS are of seven kinds: *Stipula, Bractæa, Spina, Aculeus, Cirrhus, Glandula,* and *Pilus.*

FRUCTIFICATION is performed by seven principal parts: *Calyx, Corolla, Stamina, Pistillum, Pericarpium, Semina,* and *Receptacle.*

Plants are said to be ANNUAL when they are sown, flower, produce seeds, and die, root and branch, in the course of the year in which they have vegetated: such as Mignionette, Convolvulus, Indian-pink, Lupines, Sweet-Peas, &c.

BIENNIAL PLANTS are those which totally perish the second year after they have vegetated: such as, Carnation, French Honey-suckle, Sweet-William, &c.

PERENNIAL plants are those whose roots continue alive in the ground many years: such as, Toad-flax, Daisy, Bindweed, &c.

From the examination of the layers of wood annually deposited, it has been ascertained, that olive-trees will live in favourable situations for 300, and oaks for 600 years.—It is said that Greuw, in the year 1400, cut his name on two Boababs, and that Petiver did the same 149 years after Adanson saw these names in 1749. The trees, according to his calculation, have only increased seven feet in their circumference in the course of 200 years. From which it has been inferred, that as trees of the same kind sometimes acquire a perimeter of 435 feet, they live many thousand years. The largest tree perhaps in the world, is of the same natural order as Kleinhovia; it is the Adansonia or Ethiopian Sourgourd, or African Calabash tree. Mr. Adanson says, the diameter of the trunk frequently exceeds 25 feet, and the horizontal branches are from 45 to 55 feet long; and so large, that each branch is equal to the largest trees of Europe. The breadth of the top is from 120 to 150 feet, and one of the roots bared only in part by the washing away of the earth from the river near which it grew, measured 110 feet long, and yet these stupendous trees never exceed 70 feet in height.

A ROOT is that part of the plant which rests in the ground, and supplies it with nourishment, which it draws from the juices of the earth.

The STEM, or trunk, is that part of the plant which rises out of the root, and produces the branches, leaves, and fructification.

The LEAVES are those parts of the plant which are porous on both their surfaces, and whose office it is to imbibe the air and moisture, like the lungs in animals, and to afford shade.

The PROPS, or stems or trunks of plants, are terms used to express those small parts of plants of which the chief use is to strengthen, support, and defend them.

FRUCTIFICATION is that temporary part of the plant which contains the power of reproducing it; it includes both the flower and fruit of the plant, and when perfect consists of seven principal parts, viz.

1. *The Calyx*, empalement, or flower-cup.
2. *The Corolla*, blossom, petals, or flower-leaves.
3. *The Stamina*, threads, or chives.
4. *The Pistillum*, style, or pointal.
5. *The Pericarpium*, or seed-vessel.
6. *The Semina*, or seeds themselves.
7. *The Receptaculum*, or base, on which the fructification is seated

The four first belong to the flower, the two next to the fruit, and the last is common to both.

A CALYX, empalement, or flower-cup, is that outer covering of the flower, which is the termination of the stem; and serves to inclose and protect the other parts of the fructification.

The COROLLA of a flower are the beautiful coloured leaf, or leaves, that grow within the calyx; its use is the same as that of the calyx, serving as an inner work of defence for the parts it incloses, as the calyx, which is usually of stronger texture, does for an outer one; these leaves, to distinguish them from those of the plants, are called Petals.

If the corolla consist of one leaf, it is called MONOPETALOUS; if of more than one, POLYPETALOUS.

The STAMINA are the little threads standing within the petals, and are the masculine part of the flower.

The PISTILLUM, style, or pointal, is the feminine part of the flower, commonly placed within the centre of the stamina.

The PERICARPIUM, or seed-vessel, is the germen grown to maturity after the flower is past.

The SEMINA, or seeds, are the essence of the fruit, containing the rudiment or embryo of a new vegetable. They are of various kinds, according to the plant that produces them.

The RECEPTACULUM or receptacle, is the base which connects the other six parts of fructification; it has different appellations, according to its use, figure, and situation.

FRUCTIFICATION, therefore, consists of seven principal Parts: the *Calyx*, *Corolla*, *Stamina*, *Pistillum*, *Pericarpium*, *Semina*, and the *Receptacle*.

The CALYX, is either a *Perianthium*, or flower-cup; an *Involucrum*, or a cover, an *Amentum*, or a catkin; a *Spatha*, or a sheath; a *Gluma*, or a husk; or a *Calyptra*, a veil; or a *Volva*.

The COROLLA are divided into MONOPETALOUS, which are *Campanulate*, or bell-shaped; *Infundibuliform*, or funnel-shaped; *Hypocrateriform*, or salver-shaped; *Rotatoplane*, or wheel-shaped; or *Ringent*.—POLYPETALOUS COPELLA, are, *Cruciform*, or cross-shaped; *Papilionaceous*, or butterfly-shaped.

The STAMINA consist of three parts: the *Filament;* the *Anthera*, or summit; the *Pollen*, or farina.

The PISTILLUM consists of three parts: the *Germen;* the *Style;* the *Stigma*, or rudiment.

The PERICARPIUM is either a *Capsula*, or capsule; a *Siliqua*, or pod; a *Legumen*, or pod; a *Conceptaculum*, or a conceptacle; a *Dupra*, or stone-fruit; *Pomum;* a *Bacca*, or berry; or a *Strobilus*.

The SEMINA, or seeds, consist of the *Corculum*, *Plumula*, *Rostellum*, *Cotyledon*, *Hilum*, *Arillus*, *Coronula*, *Calyculus*, or pappus, *Ala*, *Nux*, or nut, and *Propago*, or the seed of a moss.

The RECEPTACLE is either a *proper receptacle*, a *common receptacle*, an *Umbella*, or umbel, a *Cyma*, or a *Spadix*.

The CALYX has received seven different appellations, according to the circumstances with which it is attended. It is either, *Perianthium*, a flower-cup; *Involucrum*, a cover; *Amentum*, a catkin; *Spatha*, a sheath; *Gluma*, a husk; *Calyptra*, a veil; or *Volva*, membranaceous.

The PERIANTHIUM, or flower-cup, is that kind of calyx which is contiguous to the other parts of fructification, as in Heath.

The INVOLUCRUM, or cover, is that kind of calyx stationed at the foot of an umbel, at a distance from the flower: it is an universal involucrum, if it is under the universal umbel; or a partial one, if under a partial umbel, as in parsley.

The AMENTUM, or catkin, is that kind of calyx, or of inflorescence, that proceeds from a common receptacle, resembling the chaff of an ear of corn; as in the nut-tree.

The Spatha, or spathe, is a species of calyx which bursts longitudinally, in form of a sheath; as in Narcissus, Snowdrop, &c.

The Gluma, or husk, is formed of valves embracing the seed, and is a species of calyx peculiar to corn and grasses, which it folds over with its valves: the sharp point, or beard, which issues from the gluma, is called Arista.

The Calyptra, or veil, is a species of calyx peculiar to mosses, where it is placed over the anther, and in figure resembles a hood, or monk's cowl.

The Volva, is a calyx which enfolds the fungi, or mushroom tribe, before their expansion; it is membranaceous, and bursts on all sides.

The Monopetalous Corolla are divided into, *Campanulate*, bell-shaped, bellying out and without a tube, as in the Canterbury-bells.—*Infundibuliform*, funnel-shaped; it has the figure of a cone, and stands upon a long tube, as in the tobacco.—*Hypocrateriform*, salver-shaped, standing on a short tube, as in Jasmine.—*Rotatoplane*, wheel-shaped and flat, without a tube, as in Speedwell.—*Personate*, shaped like a mask, with two close lips, as in Dead Nettle.—*Ringent*, divided into two parts, called the upper and lower lip, as in Monkey-flower.

The Polypetalous Corolla are divided into, *Cruciform*, or cross-shaped, when it consists of four petals that are nearly equal, and spread at top in form of a cross, as in Stock.—*Papilionaceous*, butterfly-shaped, is composed of four or five irregular petals, of which the under one resembles the keel of a ship, and is called *Carina;* the upper one rises, and, resembling a standard, is called *Vexillum;* the two side petals, called *Alæ*, or wings, stand single, enfold the keel, and are mostly furnished at their base with two appendages like ears, as in Pea, Lupine, Laburnum.

The corolla furnishes a world for the habitation and enjoyment of tribes of insects. Of this we have an account by Sir John Hill, so curious as to merit insertion. "The principal flower in this bouquet," says he, "was a carnation; the fragrance of this led me to enjoy it frequently and near: the sense of smelling was not the only one affected on these occasions; while that was satiated with the powerful sweet, the ear was constantly attacked by an extremely soft but agreeable murmuring sound. Curiosity is a first principle in my nature on all occasions of this kind. It was easy to know that some animal within the covert, must be the musician, and that the little noise must come from some little body suited to produce it. I am furnished with apparatusses of a thousand kinds for these occasions. I instantly distended the lower part of the flower, and, placing it in a full light, could discover troops of little insects frisking and capering with wild jollity among the narrow pedestals that supported its leaves, and the little threads that occupied its centre. What a fragrant world for their habitation! what a perfect security from all annoyance in the deep husk that surrounded their scene of action!

"I was not cruel enough to pull out any one of them for examination; but adapting a microscope to take in, at one view, the whole base of the flower, I gave myself an opportunity of contemplating what they were about, and this for many days together, without giving them the least disturbance. Thus could I discover their economy, their passions, and their enjoyments. With what adoration to the Hand that gave being to these minute existences must a heart, capable of a due warmth in His praise, see the happiness he has bestowed on them! But, alas! all magnitude is but comparative; an accident of matter, not one of its properties; and, in reality, a very nothing, in no degree affecting the subjects themselves, though of such seeming consequence to us.

"The microscope, on this occasion, had given what nature seemed to have denied to the objects of contemplation. The base of the flower extended itself under its influence to a vast plain; the slender stems of the leaves became trunks of so many stately cedars; the threads in the middle seemed columns of massy structure, supporting, at the top, their several ornaments; and the narrow spaces between were enlarged into walks, parterres, and terraces.

"On the polished bottom of these, brighter than Parian marble, walked in pairs, alone, or in larger companies, the winged inhabitants: these from little dusky flies (for such only the naked eye would have shown them,) were raised to glorious glittering animals, stained with living purple, and with a glossy gold that would have made all the labours of the loom contemptible in the comparison.

"I could, at leisure, as they walked together, admire their elegant limbs, their velvet shoulders, and their silken wings; their backs vying with the empyræan in its blue; and their eyes, each formed of a thousand others, out-glittering the little planes on a brilliant; above description, and too great almost for admiration. I could observe them here singling out their favourite females, courting them with the music of their buzzing wings, with little songs formed for their little organs, leading them from walk to walk among the perfumed shades, and pointing out to their taste the drop of liquid nectar just bursting from some vein within the living trunk: here were the perfumed groves, the more than myrtle shades of the poet's fancy, realised; here the happy lovers spent their days in joyful dalliance; or, in the triumph of their little hearts, skipped after one another from stem to stem among the painted trees; or winged their short flight to the close shadow of some broader leaf, to revel undisturbed in the heights of all felicity."

There belongs to the corolla a part called the Nectarium, appropriated for containing the honey, a sweet juice that oozes from the plant, and forms the principal food of bees and other insects. It has been but lately distinguished, having been by former botanists confounded with the petals. It commonly makes a part of the corolla, but is sometimes entirely distinct from it. In figure it resembles a honey-cup, and sometimes a cup, and hence named Honey-cup. In some plants it is very large, as in the *Daffodil*, and *Columbine;* in the former of which the cup, and in the latter the horns, are *Nectaria.* In others it is scarce discoverable, even with the help of microscopes.

A NECTARY is that part of the corolla which secretes honey. It varies considerably in different flowers, and is frequently a distinguished ornament in each. In the *(aconitum napellus,)* monk's-hood, they stand upright, like horns, covered with a hood, containing so much acrid matter that insects rarely penetrate it. In the *(Helliborus,)* Christmas rose, they are like pitchers placed in a circle, and much enhance the beauty of the flower. In the columbine, a lively imagination may liken the nectary to the neck and body of a bird, and the two petals on each side to the wings of the hovering dove. Hence the name of columbine, as if resembling a nest of young pigeons fluttering, while the parent feeds them. In flowers of one petal, as the *(lamium album,)* white archangel, the tube of the corolla contains, and probably secretes honey, without any evident nectary. In the *(viola,)* violet, the nectary is an elongation of the corolla; sometimes, as in the garden nasturtium, an elongation of the calyx. The most indubitable nectaries, as actually secreting honey, are the glandular; as placed on the germen of the gilliflower and turnip. In cruciform plants *(tetradynamia,)* they form generally four green glands at the base of the stamens. Honey is not absolutely confined to the flower. The glands on the footstalks of the *(passiflora cærulea,)* blue-rayed passion-flower, yield it; and it also exudes from the stalks of some liliaceous plants. Many opinions have been formed concerning the use of this viscid liquor: Sir E. Smith is of opinion, that it is designed to allure insects; by which the dust of the stamen is disturbed, and an important purpose answered in the economy.

Many insects are provided with a long and pliant proboscis, for the purpose of acquiring this grateful food: as a variety of bees, moths, and butterflies; but the *(sphinx convolvuli,)* unicorn-moth is furnished with the most remarkable proboscis in this climate. It carries it rolled up in concentric circles under its chin, and occasionally extends it to above three inches in length; this trunk consists of joints and muscles, and seems to have more versatile movements than the trunk of the elephant; and near its termination is split into two capillary tubes. The excellence of this contrivance for robbing the flowers of the honey keeps this insect fat and bulky, though it flies only in the evening, when the flowers have closed their petals, and are thence more difficult of access. Besides these, there is a curious contrivance attending the *ophyrys*, commonly called the *bee-orchis*, and the *fly-orchis*, with some kinds of the *delphinium*, called *bee-larkspurs*, to preserve their honey; in these the nectary and petals resemble, in form and colour, the insects which plunder them; and thus, it may be supposed, they often escape these hourly robbers by having the appearance of being pre-occupied.

Each STAMEN consists of three parts: the *Filament;* the *Anthera*, or Summit; the *Pollen*, or Farina.

The *Filament* is that part of the stamen which serves to elevate the anthera, or summit, and at the same time connects it with the flower.—The *Anthera* is the summit of the filament; it contains within it the pollen, or farina, which it discharges when come to maturity.—The *Pollen*, or farina, is a fertilizing dust-like fine meal contained within the anthera, and dispersed upon the pistillum when ripe, for the purpose of impregnation.

Each PISTIL consists of three parts: the *Germen;* the *Style;* and the *Stigma.*

The *Germen* is the foundation or rudiment of the fruit accompanying the flower, but not yet arrived at maturity. —The *Style* is that part of the pistillum which serves to elevate the stigma from the germen.—The *Stigma* is the summit of the Pistillum, covered with a moisture that receives the pollen.

The PERICARPIUM (fruit or nut) SEED-VESSEL, is distinguished, according to the circumstances that attend it, by the following appellations:—

Capsula, a capsule; *Siliqua*, a pod; *Legumen*, a pod also; *Conceptaculum*, a conceptacle; *Drupa*, a stone fruit; *Pomum;* *Bacca*, a berry; and *Strobilus.*

The *Capsula*, or capsule, is a membranaceous hollow pericarpium which cleaves or parts in some determinate manner, or differently, in different plants. It is composed of *valves*, or the outer covering; of the partitions which divide it; of the columella, or central pillar; and of the cells which contain the seeds; as in the Poppy.

The *Siliqua*, a pod, is an oblong membranaceous pericarpium of two valves, wherein the seeds are fastened along both the sutures or joinings of the valves; as in the Stock July-flower. A short pod, is to be considered as a species of Siliqua, but is nevertheless an important distinction.

The *Legumen*, a pod also, is a pericarpium of two valves, wherein the seeds are fastened along one suture only; as in the Pea.

A *Conceptacle* (follicle or bag) is a pericarpium of one valve, which opens on one side lengthways, having the seeds loose in it; as in Rosebay, Swallow-wort.

Drupa is a fleshy or pulpy pericarpium without valves, containing a nut or stone, with a kernel; as in the Cherry.

Pomum is a fleshy or pulpy pericarpium without valves, containing a capsula; as in the Apple and Pear.

Bacca, a berry, is a succulent or pulpy pericarpium without valves, containing naked seeds; as in the Gooseberry.

A compound berry consists of many single ones fastened together: as in Raspberry.

Strobilus, a strobile, is a pericarpium formed from an amentum, contracted together with hard scales that are imbricate and lie over each other; as in the Pine-tree.

The SEEDS of plants exhibit great diversity in number, size, and figure. Sometimes they are few; in other instances numerous.—In one plant of white poppy, Grew reckoned 32,000 seeds; and on the spike of a species of typha, he numbered 40,176 seeds; so that, upon the three spikes which one stalk of this plant bears, there are every year produced above 120,000 seeds. In figure, the varieties in seeds are also so numerous as to baffle description; and, with respect to size, many are so minute as not to be visible to the naked eye, and others are very large.

The SEED consists of *Cotyledon*, a side lobe of the seed, of a porous substance and perishable.—*Arillus*, the proper exterior coat or tunic of the seed, which falls off spontaneously.—*Corculum*, the first principle of the new plant within the seed.—*Plumula*, a scaly part of the corculum which ascends.—*Rostellum*, a plain part of the corculum which descends.—*Coronula*, the little crown and seed, which is either *calyculus*, the calyx of the floret, adhering to the seed and assisting its depression; or *pappus*, a crown, which is a feathery or hairy down, answering the same end, and connecting with the seed by *stipes*, a trunk, which here signifies the thread on which the down is raised and supported.—*Ala*, wing, a membrane affixed to the seed, and which, by its flying, helps to disperse it.—*Nux*, a nut, which is a seed inclosed with a bony or hard outer skin, commonly called the shell.—*Propago*, which is the seed of a moss.—The *Hilum*, is the external mark or scar on the seeds, by which they adhere to the fruit.

The SEED of the plant, after it has dropped from the pod or husk, may be considered as an impregnated egg, within which the embryo plant is securely lodged. In a few days after it has been committed to the earth, may be observed the rudiments of the future plant, every part of which appears to exist in miniature. The nutritious juices of the soil insinuate themselves between the original particles of the plant, and bring about an extension of its parts.

Nature assists to sow and plant, as well as to fertilize the earth. The seeds of lofty trees are many of them winged; and, when they are ripe, the autumnal winds blow them off, and scatter them at a great distance from their mother plants. Others are in pods or husks, and not capable of being carried by the motion of the air; but Providence has given them as food to birds, who carry them to distant places, and, in feeding, scatter the seed in soils proper for them to take root. Farinaceous vegetables and oviparous animals are nourished in their tender state nearly in the same manner. The embryo plant is supported by the farina melted down into a milky liquor, and conveyed into its body by means of an umbilical chord, at a time when the radicle is unable to supply a sufficiency of nutriment. In oviparous animals the yolk of the egg, remaining entire during incubation, is received into the body of the animal, and, in a manner similar to the milky juice of the vegetable, is slowly conveyed into the vessels of the tender chick.

The receptacle consists of a *proper receptacle;* a *common receptacle; Umbella,* an umbel; *Cyma,* a cyme; and *Spadix.*

A proper receptacle is that which supports the parts of a single fructification.—*A receptacle of the fructification,* when it is common to both flower and fruit.—*A receptacle of the flower,* when it is a base to which the parts of the flower, exclusive of the germen, are fastened.—*A receptacle of the fruit,* when it is a base for the fruit only, remote from the receptacle of the flower:—and *a receptacle of the seeds,* when it is a base that fastens the seeds within the pericarpium.

A common receptacle is that which connects several florets, or distinct fructifications, in such a manner, so that the taking away of any one of them would cause an irregularity. That thin substance which springs from the receptacle and parts the florets, is called *Palea,* a chaff.

Umbella, an umbel, is a receptacle which, from a common centre runs out into thread-shaped foot-stalks of proportionate lengths. It is called a *simple umbel,* when it has no subdivisions; a *compound umbel,* when each foot-stalk is terminated by an *umbellula,* or *little umbel;* and, in this case, the umbel that bears the *umbellula* on its foot-stalks is called a *universal umbel;* and the umbellula which proceeds from the universal umbel, a *partial umbel,* as in Chervil.

Cyma, a cyme, is a receptacle that runs into long fastigiate peduncles, proceeding from the same universal centre, but with irregular partial ones; as in Elder.

Spadix is the receptacle of a palm, produced within a *spatha*, or sheath, on the branches that bear fruit. The term *spadix* is also used in a more general sense, to express all flower-stalks that come out of a spatha; as in the Cuckow-pint.

A Root consists of two parts: *Caudex*, the stock or body of the root.—*Radicula*, the radicle or little root, which is the fibrose part of it terminating the descending caudex, and enabling the root to imbibe nourishment for the support of the vegetable. Roots are distinguished by different names, according to their forms. They are called *simple*, *ramose*, *bulbose*, *tuberose*, *articulate*, *fusiform*, *globose*, *repent*, *fibrose*, *præmorse*, and *palmate*.

The roots are *simple* when they have no subdivisions: as in Radish.—The roots are *ramose*, or branching, when they are divided into lateral branches.—The *bulbous* roots are those which are furnished with a bulb; as a Tulip-root.—The *tuberous* roots are those which consist of roundish fleshy bodies, connected by slender fibres into a bunch; as in Orchis, Wood-pea, Pæony, Potatoe. The *articulate* roots are those which are divided into joints; as in Wood-sorrel.—A root is *fusiform*, or spindle-shaped, when it is oblong, thick, and tapering to a point; as Carrots, Radish, Parsnip, &c.—A root is *globose* when it is globe-shaped with lateral radicles; as in some species of Ranunculus, Earth-nut.—Roots are called *repent*, or *creeping*, when they run out to a distance, and put forth radicles from space to space, as in Mint, &c.—Roots are *fibrose* when they consist only of fibrose radicles; as in Grasses.—A root is *præmorse*, or bitten off, when the lower part is truncate, and the termination abrupt; as in Valerian, Plantain, &c.—A *palmate* root consists of several oblong knobs, spreading out like the fingers, as in some species of Orchis.

The Trunk is subdivided into seven kinds: *Caulis*, or stem, properly so called; *Culmus*, or straw; *Scapus*, or stalk; *Peduncle*, or foot-stalk of the fructification; *Petiole*, or foot-stalk of a leaf; *Frons*, and *Stipes*.

The *caulis*, or *stem*, is the proper trunk of the herb, and serves to elevate the leaves, branches, flower, and fruit. It is either simple or compound. Simple stems are such as do not divide, but proceed in a continued series towards their summits; as in Palms. Compound stems are such as are subdivided into *ramuli*, or small branches, and diminish as they ascend; as in Myrtle.

No certain limit has been hitherto discovered to the growth of ligneous stems, for we see them increasing in the magnitude far beyond the recollection of man, and we know not when it is to cease. Two facts connected with this subject has been determined, and it is this, that there is great variety in the dimensions of different species, and that some possess the power of increase very differently from others. One class of trees vegetate with extraordinary rapidity; of this we have remarkable examples in the poplar and willow: others again are as noted for the slowness of their growth, as the oak. Many instances of the enormous magnitude of trees are recorded. Pliny mentions a tree (*Platanus*) in the hollow trunk of which Lucian, the Roman consul, supped and slept with twenty people. Humboldt saw a large tree, the diameter of which was seventeen feet. The famous chesnut-tree on Etna (*Centum Cavalli*), is one of those extraordinary productions of nature, though scarcely more so than the celebrated pear-tree in Herefordshire. But the most extraordinary vegetable production of which we know any thing, is the *Adansonia digitata*, a native of Africa. Its diameter is said to be thirty feet, and its circumference ninety feet. Its branches are from thirty to sixty feet long, and the hollow of its trunk is the habitation of many negro families.

Culmus, or a straw, is the proper stem or trunk of corn and grass, usually jointed and hollow, and serves to elevate both the leaves and the fructification.

Scapus, a stalk, is a universal trunk, bearing the fructification without the leaves; as in Narcissus, Hyacinthus, and Leucojum.

A *peduncle*, or foot-stalk of a flower, is a partial trunk, bearing the fructification without the leaves.

A *petiole*, or foot-stalk of a leaf, is a species of trunk that fastens the leaves, but not the fructification; which circumstance distinguishes it from a peduncle, which is the foot-stalk of a flower.

Frons, or frond, is a species of trunk which has the branch united with the leaf, and with the fructification; it belongs properly to the Palms and Ferns.

Stipes, or stipe, is used to express the base or trunk of a frond; or a species of stem passing into leaves, or not distinct from the leaf. It is applied only to the Palms, Filices, and Fungi.

The LEAVES, with regard to form, are divided into *Simple* or *Compound*.

Simple leaves are such as have only a single leaf on a petiole. They differ in respect to circumscription, angles, sinus, apices, margin, superficies, and substance.—*Circum-*

scription considers the form of the circumference of leaves where there are no angles or sinuations.—The *angles* are the prominent parts of an horizontal leaf.—The *sinus*, or hollow, is a term used to express those openings and cavities in leaves which distinguish them into parts.—The *apex*, tip, is the extremity in which the leaf terminates.—The *margin* of a leaf is the outermost boundary of its sides, exclusive of its disk.—The *superficies*, surface, is the outside, or what covers the disk of the leaf, and respects both the supine disk, or face of the leaf, and prone disk, or back of it.—The *substance* of a leaf respects the conditions of its sides.

A leaf is said to be *compound* when there are more than one upon a petiole or foot-stalk. Compound leaves are to be considered in respect to structure and degree.—By the *structure* of a compound leaf, is to be understood the insertion of the folioles, or lesser leaves, of which it is compounded.—The *degree*, in a compound leaf, respects the subdivision of the common petiole.

LEAVES may likewise be considered as to their determination, by which is to be understood their character, expressed from some circumstance foreign to their own particular structure or configuration; as from their place, situation, insertion, or direction.—By the *place* of a leaf, is meant the part where it is fastened to the plant.—By *situation*, the disposition of the leaves on the stem of the plant.—By *insertion*, the manner in which the leaf is fixed to the petiole.—And by *direction*, the particular manner in which the leaves grow.

Akin to flowers, in the beauty of their conformation, are leaves; and the talipot-leaf is a magnificent illustration It is completely circular, terminating in the most beautiful rays; it folds up into plaits like a fan, which in figure it nearly resembles. In size and thickness it completely surpasses almost all other leaves. The breadth of the diameter is from three to four feet, and the length and thickness is in proportion; it is large enough to cover ten men from the inclemency of the weather. It is made into umbrellas of all sizes, and serves equally to protect the natives against the intolerable rays of the sun, and the rains which, at particular seasons, deluge their country. As it is of such an impenetrable texture as to defy either the sun or the *monsoon*, it affords a shelter even more secure than their huts. During the violent rains it is not unusual to see the natives prop up one end of a talipot-leaf with a stick two or three feet long, and then creep under it for protection. But the largest leaved plant in the world, is the *troolie* of Surinam; it extends on the ground, and has frequently been known to attain the width of three feet, and the length of thirty. The natives cover their houses with it; and it is very durable.

The Props, or fulcra, or trunks, are of seven kinds: *Stipula; Bractea; Spina; Aculeus; Cirrhus; Glandula;* and *Pilus. Stipula* is a scale or small leaf, stationed on the base of the petioles or peduncles, as in the Passion-flower.—*Bractea,* a florel-leaf, a leafy appendage to the flower or its stalk; it is of a variety of forms; sometimes green, as in Passiflora, sometimes coloured, as in Sage.—*Spina,* a thorn, is a kind of sharp weapon or armature, protruded from the wood of the plant; as in Acacia tree, Black Thorn, &c.—*Aculeus,* a prickle, is the same sort of armature proceeding from the cortex of the plant only; as in Rose, Bramble, &c.—*Cirrhus,* a clasper or tendril, is a filiform spiral band, by which a plant is fastened to another body; as in the Ivy, Vine, &c.—*Glandula,* a little gland, is a species of excretory or secretory duct or vessel, found on the surface of some plants. Its situation is commonly on the leaves, the petioles, the peduncles, or the stipules; as in Passion-flower.—*Pilus,* a hair, is a sort of bristle, serving as an excretory duct to the plants.

Plants are divided, according to the system of Lynnæus, into twenty-four *Classes;* these classes are subdivided into about 120 *Orders:* these orders contain about 1800 *Families* or *Genera;* and these families about 20,000 *Species,* besides the innumerable varieties which the accidents of climate or cultivation have added to these species.

The *Classes* are distinguished from each other by the number, situation, adhesion, or reciprocal proportion of the stamens in each flower.

The *Orders,* in the thirteen first classes, are distinguished by the number of pistils; in the fourteenth and fifteenth, by the pericarpium; in the nineteenth, by the disposition and character of the florets; in the sixteenth, seventeenth, eighteenth, and the remaining classes, by the number and other local varieties of the stamens.

The *Families* or *Genera,* are characterised by the analogy of all the parts of the flower or fructification.

The *Species* are distinguished by the foliage of the plant.

And the *Varieties* by any accidental circumstance of colour, taste, or odour.

Division of the Classes.

The classes may be divided, according to their distinctive properties, into six parts.

1. The eleven first classes form the first division, and include the plants that are complete; that is to say, whose flowers have both stamens and pistils, and in which the stamens, all equal in height, are entirely separated from the pistil, and from each other, from top to bottom. In the ten first classes, from one to ten inclusive, the number of stamens determines the class; and in the eleventh class all the plants are comprehended that have any number of stamens from twelve to nineteen inclusive, provided they be disunited. No flowers have yet been found to have eleven stamens, which is the reason no class has been allotted to that number.

2. In the twelfth and thirteenth class the situation of the stamens, of one length and disunited, is to be considered. The stamens, in the former, are either on the calyx or corolla; in the latter, on the base or receptacle of the flower.

3. In the fourteenth and fifteenth, not only the number of stamens are to be considered, but the reciprocal proportions in respect to height. The fourteenth class has four stamens, two longer. The fifteenth, six stamens, two shorter.

4. The five subsequent classes are distinguished, not by the number of stamens, but by their union or adhesion, either by their anthers or filaments, or to the pistil. The sixteenth class has the filaments united into one body, the seventeenth into two bodies, the eighteenth into three or more bodies, the nineteenth has many stamens united by their anthers, and the twentieth many stamens attached to the pistil.

5. The next three classes consist of incomplete plants, which have stamens only, or pistils only. The twenty-first class has its pistils and stamens on separate flowers, but on the same plant. The twenty-second class has its stamens and pistils on separate plants; and the twenty-third class consists of plants that are both complete and incomplete, and whose flowers contain both the properties of the two preceding classes.

6. The next class consists of inconspicuous plants. It contains the plants whose flowers are very small, invisible, or not yet discovered.

The *phlox divaricata* and *subulata* are the most conspicuous ornaments of spring. They were first known by the appellation of *lychnidea*, which signifies a candle, or something luminous. *Phlox*, a flame; *subulata*, awl-shaped; *divaricata*, spreading like a panicle. These names seem to be founded on an analogy between the appearance or habits of the flowers, and their radicle meanings. In like manner, *clematis* signifies fragibility; *iris*, rainbow. The graceful curve of its petals, and their brilliant tints, readily assimilating it to the painted arch of Iris. *Mesembryanthemum*, noon-flower, from the regular closing of its petals at that hour. *Campanula*, little bell; *cerea*, waxy. *Amaranthus*, without decay; everlasting flower; aptly applied to that elegant class of plants which retain their beauty through successive seasons, and form distinguished ornaments in winter bouquets. *Helianthus*, sun-flower. *Origanum*, an ornamental mountain-plant. *Hemerocallis*, beauty of a day.

Count with nice eye the myriad Seeds that swell
Each vaulted womb of husk, or pod, or shell;
Lo! on each Seed within its slender rind
Life's golden threads in endless circles wind.
Maze within maze the lucid webs are roll'd;
And as they burst, the living flame unfold.
The pulpy acorn, ere it swells, contains
The oak's vast branches in its milky veins;
The young Narcissus, in its bulb compress'd,
Cradles a second nestling on its breast.
Grain within grain successive harvests swell
And boundless forests slumber in a shell.
Teach the fine Seed, instinct with life, to shoot
On earth's cold bosom its descending root;
With pith elastic stretch its rising stem,
Part the twin lobes, expand the throbbing gem.
Bid the clos'd *coral* from nocturnal cold
Curtain'd with silk the virgin *stigma* fold,
Shake into viewless air the morning dews,
And wave in light its iridescent hues.
So shall from high the bursting *anther* trust
To the mild breezes the prolific dust;
Or bow his waxen head with graceful pride,
Watch the first blushes of his waking bride,
Give to her hand the honey'd cup, or sip
Celestial nectar from her sweeter lip;
Hang in soft raptures o'er the yielding fair,
Love out his hour, and leave his life in air.
Closed in the *style* the tender pith shall end.
The lengthening wood in circling *stamens* bend;
The smoother rind its soft embroidery spread;
In vaulted *petals* o'er the gorgeous bed.
The wrinkled *bark*, in filmy mazes roll'd
Form the green *calyx*, fold including fold;
Each widening *bracte* expand its foliage hard,
And hem the bright pavilion, *Flora guard.*

Darwin.

The following are the several Orders in the System of Linnæus.

I. Monandria, *One stamen*—1. *Monogynia*, One pistil. 2. *Digynia*, Two pistils.

II. Diandria, *Two stamens*—1. *Monogynia*, One pistil. 2. *Digynia*, Two pistils. 3. *Trigynia*, Three pistils.

III. Triandria, *Three stamens*—1. *Monogynia*, One pistil. 2. *Digynia*, Two pistils. 3. *Trigynia*, Three pistils.

IV. Tetrandria, *Four equal stamens*—1. *Monogynia*, One pistil. 2. *Digynia*, Two pistils. 3. *Tetragynia*, Four pistils.

V. Pentandria, *Five stamens*—1. *Monogynia*, One pistil. 2. *Digynia*, Two pistils. 3. *Trigynia*, Three pistils. 4. *Tetragynia*, Four pistils. 5. *Pentagynia*, Five pistils. 6. *Polygynia*, Many pistils.

VI. Hexandria, *Six equal stamens*—1. *Monogynia*, One pistil. 2. *Digynia*, Two pistils. 3. *Trigynia*, Three pistils. 4. *Tetragynia*, Four pistils. 5. *Polygynia*, Many pistils.

VII. Heptandria, *Seven stamens*—1. *Monogynia*, One pistil. 2. *Digynia*, Two pistils. 3. *Tetragynia*, Four pistils. 4. *Heptagynia*, Seven pistils.

VIII. Octandria, *Eight stamens*—1. *Monogynia*, One pistil. 2. *Digynia*, Two pistils. 3. *Trigynia*, Three pistils. 4. *Tetragynia*, Four pistils.

IX. Enneandria, *Nine stamens*—1. *Monogynia*, One pistil. 2. *Trigynia*, Three pistils. 3. *Hexagynia*, Six pistils.

X. Decandria, *Ten stamens*—1. *Monogynia*, One pistil. 2. *Digynia*, Two pistils. 3. *Trigynia*, Three pistils. 4. *Tetragynia*, Four pistils. 5. *Pentagynia*, Five pistils. 6. *Decagynia*, Ten pistils.

XI. Dodecandria, *Twelve stamens (from 11 to 19)*—1. *Monogynia*, One pistil. 2. *Digynia*, Two pistils. 3. *Trigynia*, Three pistils. 4. *Pentagynia*, Five pistils. 5. *Dodecagynia*, Twelve pistils.

XII. Icosandria, *Twenty stamens (on the calyx or corol)*—1. *Monogynia*, One pistil. 2. *Digynia*, Two pistils. 3. *Trigynia*, Three pistils. 4. *Pentagynia*, Five pistils. 5. *Polygynia*, Many pistils.

XIII. Polyandria, *Many stamens (from 20 to 1,000 on the receptacle)*—1. *Monogynia*, One pistil. 2. *Digynia*, Two pistils. 3. *Trigynia*, Three pistils. 4. *Tetragynia*, Four pistils. 5. *Pentagynia*, Five pistils. 6. *Hexagynia*, Six pistils. 7. *Polygynia*, Many pistils.

XIV. Didynamia, *Four stamens, 2 longer and 2 shorter*—1. *Gymnospermia*, Four naked seeds. 2. *Angiospermia*, Seeds enclosed in a pericarp

XV. Tetradynamia, *Six stamens, 4 longer and 2 shorter*—1. *Siliculosa*, Pericarp generally roundish, with the style persistent, or continuing, called a silicle. 2. *Siliquosa*, Pericarp, very long and narrow, called a silique or pod.

XVI. Monadelphia, *One brotherhood or filaments, all connected*—1. *Triandria*, Three stamens. 2. *Pentandria*, Five stamens. 3. *Octandria*, Eight stamens. 4. *Decandria*, Ten stamens. 5. *Endecandria*, Eleven stamens. 6. *Dodecandria*, Twelve stamens. 7. *Polyandria*, Many stamens.

XVII. Diadelphia, *Two brotherhoods or filaments, in two bodies*—1. *Pentandria*, Five stamens. 2. *Hexandria*, Six stamens. 3. *Octandria*, Eight stamens. 4. *Decandria*, Ten stamens.

XVIII. Polyadelphia, *Many brotherhoods, filaments in three or more parcels*—1. *Pentandria*, Five stamens. 2. *Dodecandria*, Twelve stamens. 3. *Icosandria*, Twenty stamens. 4. *Polyandria*, Many stamens.

XIX. SYNGENESIA, *Congeneration, anthers united*—1. *Polygamia Æqualis*, All the floscules perfect, and the whole flower regular. 2. *Polygamia superflua*, Perfect floscules in the disk, pistilliferous floscules in the ray, both producing seed. 3. *Polygamia Frustranea*, Floscules in the disk perfect and producing seed, in the ray imperfect, and without seed. 4. *Polygamia Necessaria*, Floscules in appearance, perfect in the disk, producing no seed, pistilliferous floscules in the ray, producing no seed. 5. *Polygamia Segregatu*, Many floriferous calyxes contained in one common calyx and forming one flower. 6. *Monogamia*, Flowers not compound as in the other orders, but simple as in all the other classes.

XX. GYNANDRIA, *Stamens growing on the pistil*—1. *Diandria*, Two stamens. 2. *Triandria*, Three stamens. 3. *Tetrandria*, Four stamens. 4. *Pentandria*, Five stamens. 5. *Hexandria*, Six stamens. 6. *Octandria*, Eight stamens. 7. *Decandria*, Ten stamens. 8. *Dodecandria*, Twelve stamens. 9. *Polyandria*, Many stamens.

XXI. MONOECIA, *One house.—Imperfect flowers separate on the same plant*—1. *Monandria*, One stamen. 2. *Diandria*, Two stamens. 3. *Triandria*, Three stamens. 4. *Tetrandria*, Four stamens. 5. *Pentandria*, Five stamens. 6. *Hexandria*, Six stamens. 7. *Heptandria*, Seven stamens. 8. *Polyandria*, Many stamens. 9. *Monadelphia*, Filaments united in one. 10. *Syngenesia*, Anthers united. 11. *Gynandria*, Stamens on the pistil.

XXII. DIOECIA, *Two houses. Imperfect flowers on distinct individuals*—1. *Monandria*, One stamen. 2. *Diandria*, Two stamens. 3. *Triandria*, Three stamens. 4. *Tetrandria*, Four stamens. 5. *Petandria*, Five stamens. 6. *Hexandria*, Six stamens. 7. *Octandria*, Eight stamens. 8. *Enneandria*, Nine stamens. 9. *Decandria*, Ten stamens. 10. *Dodecandria* Twelve stamens. 11. *Polyandria*, Many stamens. 12. *Monodelphia*, Filaments united in one. 13. *Syngenesia*, Anthers united. 14. *Gynandria*, Stamens on the pistil.

XXIII. POLYGAMIA, *Perfect flowers, accompanied with one or both sorts of imperfect flowers*—1. *Monoecia*, Perfect and imperfect flowers on the same plant. 2. *Dioecia*, Perfect flowers on one plant and imperfect on another. 3. *Trioecia*, Perfect flowers on one plant. Staminiferous flowers on a second, and pistilliferous flowers on a third.

XXIV. CRYPTOGAMIA, *Fructification secret*—1. *Filices*, Ferns, bearing seed on the back of the leaves. 2. *Musci*, Mosses having imperfect flowers distinct, and the seeds in a capsule often covered in a veil. 3. *Algæ*, Having imperfect flowers distinct, and the seeds either like a meal on the leaves, or inclosed in bladders. 4. *Fungi*, Having no discernible flowers, but seeds in the gills, pores, cups, &c.

XXV. *Palms*. Flowers on a spadix, in a spathe or sheath, generally staminiferous and pistilliferous distinct.

Under this name Linnæus has arranged several large trees, which, although capable of a place in separate classes of his System, he chooses rather, on account of their singular structure, to place apart in an Appendix. It may not, however, be improper to remark, that later Botanists have arranged them in the three last classes, to which, from their character, they properly belong. This order contains about twenty genera, whose flowers and fruit are produced on that particular receptacle, or seat, called a Spadix, and proceeding from a common calyx in form of a sheath, termed by Linnæus a Spatha. The most remarkable of these are *Cocos*, the Cocoa-tree; and *Phœnix*, the Palm-tree, which flourishes with greater luxuriance after having been destroyed to the root by fire; they are remarkable for their prodigious height, and are distinguished by an unvaried, undivided perennial trunk, crowned at the top by an evergreen bunch of leaves, rich in abundance of fine large fruit.

LECTURE LXXIV.

THE GEOGRAPHY OF PLANTS.

" There lives and works
A soul in all things, and that soul is God.
The beauties of the wilderness are his,
That make so gay the solitary place
Where no eye sees them. And the fairer forms
That cultivation glories in are his.
He sets the bright procession on its way,
And marshals all the order of the year.
He marks the bounds that winter may not pass,
And blunts his pointed fury: in its case,
Russet and rude, folds up the tender germe,
Uninjur'd, with inimitable art;
And, ere one flow'ry season fades and dies,
Designs the blooming wonders of the next."

THE Geography of plants teaches us to know the appearance, dissemination, and distribution of plants, as these exist at present; with a due consideration of other matters connected with them. It considers the different habitats or localities of plants, and the distinction between the social, the solitary, the plentiful, and the rare, in occurrence. It determines the extent of districts over which various plants spread; and the laws according to which, not merely the whole vegetable world, but likewise particular families and genera, are distributed, in respect to geographical longitude, latitude, altitude, &c. It borrows from physics and physiology, the laws whereby external circumstances, soil, temperature, moisture, &c., act upon vegetables, for comparison with those which govern the geographical distribution.

The history of plants teaches us the laws, the varieties, and the decay, of their organization; as well as their culture and uses. It is one of the most important studies of man. It directs him in the choice of food, that enables him to add to his resources in quantity and flavour. But besides aiding him with the most wholesome nutriment, it affords him medicines to relieve his excesses, and cure the entire train of his numerous maladies. It guides him also in the choice of clothing; and in the appropriation of the infinitude of vegetable qualities, and all the purposes of the useful and elegant arts.

M. **Humboldt** considers 38,000 as the full number known in catalogues and herbaria of *phanerogamous* plants, or plants possessing visible stamens and pistils, or visible organs of fructification.

He distributes these 38,000 plants thus:

In Europe	7,000
In Asia, temperate zone	1,500
In Asia, torrid zone	4,500
In Africa	3,000
In the two temperate zones of America	4,000
In the torrid zone of America	13,000
In New Holland and the Islands of the South Sea	5,000
	38,000

Humboldt first presents a curious view of the varieties which regions of different altitude afford, in respect to climate and vegetation in the equatorial zone, in America. These varieties are given first for the zone between 0° and 10°, and then for that between 17° and 21° of latitude, and in both zones, in respect to altitude, three regions are considered, hot, temperate, and frigid.

He then notices the varieties which difference of altitude produces in the temperate and frigid zones; for instance, in the Pyrenees, Caucasus, Switzerland, and Lapland, he places the limits of Betula Alba upon the Caucasus, at 6,300 feet.

All the results are represented in the ENGRAVING, in which a comparative view is afforded of the varieties at different altitudes. To render this comparison more complete, we add the observations of Wahlenberg in the Carpathian Alps; and present a similar view of the Norwegian chain, from 60° to 61° of latitude.

	Carpathian Alps. Lat. 46°	*Norwegian Alps.* Lat. 60° 61.
Snow-line	8,000 feet.	5,000 feet.
Distance of the limit of trees from the snow-line	3,500	2,000
Height of the limit of trees	4,500	3,200
Trees which this limit presents	*Pinus Abies*	*Betula alba*
Limit of shrubs	5,500	3,800
Shrubs which this limit presents	*Pinus Mughus*	*Betula nana* *Salix glauca*
Distance of the limit of corn from the snow-line	5,300	3,100

From a comparison between the vegetation of mountains in different climates, abstracting all anomalies arising out of particular local relations, Humboldt deduced the law, that the limit of trees, drawn from the equator towards the north pole, does not run parallel to the snow-line, but converges towards it. It is not the annual mean temperature which determines the vegetation, but the temperature which prevails within the cycle of vegetation; hence towards the north pole, the vegetation is richer in proportion to the difference between the different periods of the year; for the summer day towards the pole is always longer, and consequently the plants receive more heat, and the difference between the temperature of day and night is less.

The difference of altitude, does not, however, stand in the same relation with the difference produced by difference of latitude. The limit of trees, in respect to latitude, is proportionally much more extended towards the pole, than upon the equatorial mountains. If the proportions were the same, all vegetation of trees would cease at 60° of latitude. Corn ascends, according to Humboldt, at the equator, to the height of 9,600 feet, but if in a higher latitude, a similar proportion took place, corn would not be seen beyond 54° of latitude. But in Lapland, it is cultivated as far as 68° and 70°. Quito has not the same latitude as France or Italy; because, though the mean temperature of both places is the same, the distribution of heat is very different.

In the Himmalayan chain, Captain Webb saw fields of barley, at the height of 11,500 feet, and at 11,630 feet; a forest rich in pines, oak, and rhododendra; there was a luxuriant vegetation, and strawberries were in full flower in June, at the height of 12,642 feet; there was still no snow: but dandelions, buttercups, and a great profusion of other flowers; plants of spikenard were observed at 12,900 feet; and at 13,500 was the limit of vegetation.

It is in the torrid zone that Nature displays the most profuse and brilliant vegetation. The vegetable forms near the equator are in general more majestic, more imposing; the varnish of the leaves is more brilliant. The largest trees are perpetually adorned with flowers, larger, more beautiful, and more odoriferous, than herbaceous plants in the temperate climates. Some of these sons of the forest attain a gigantic magnitude, of which the native of a northern climate is unable to form a conception. In the plains watered by the Senegal, springs the mighty Baobab, the trunk of which attains a circumference of 50, 60, or 70 feet; while its branches, each equalling an ordinary tree in magnitude, spread out on all sides, and convert a single plant into a species of forest. Although this is probably the largest tree on the globe, there are others not greatly inferior in the tropical regions of Asia and America. No feature is more characteristic of a tropical landscape than the number and variety of palms, which raise to a lofty height their slender trunk, destitute of branches, but covered by a thick tuft of leaves. The largest of this species is the great fan palm (corypha umbraculifera), which grows in some parts of India, one leaf of which will cover ten or a dozen men, and two or three are sufficient to roof a cottage. *(See the engraving of a Brazilian forest.)*

No forests approach in magnificence those which shade the equinoctial regions of Africa and America. One is never satiated in admiring there the endless multitude of vegetables brought into near contact with each other, and mingled promiscuously together; so different among themselves, and often so extraordinary in structure and produce; these enormous trees, still exhibiting no symptoms of decay, though their age goes back to a period but little distant from the last revolution of the globe; those towering palms, contrasting, by their simple forms, with all that surround them; those extensive climbers; those rattans, which, knitting together their long and flexible branches by numberless knots and turns, encircle as one group the whole vegetation of these extensive regions. To clear a path through these, neither fire nor axe are sufficient; the one extinguishes for want of circulation in the air, the other is broken or blunted by the hardness of the wood it meets. The soil cannot afford place to the numberless germs which it developes. Each tree disputes with others, which press from all sides, the soil necessary for existence; the strong stifle the weak; while rising generations obliterate even the slightest trace of destruction and death;

vegetation never flags; and the earth, so far from becoming exhausted, daily acquires new fertility. Hosts of animals of every kind, insects, birds, quadrupeds, reptiles; beings as diversified and strange as the vegetation of the place itself, withdraw themselves under the vast canopy of these ancient thickets, as into a citadel proof against the attack of man.

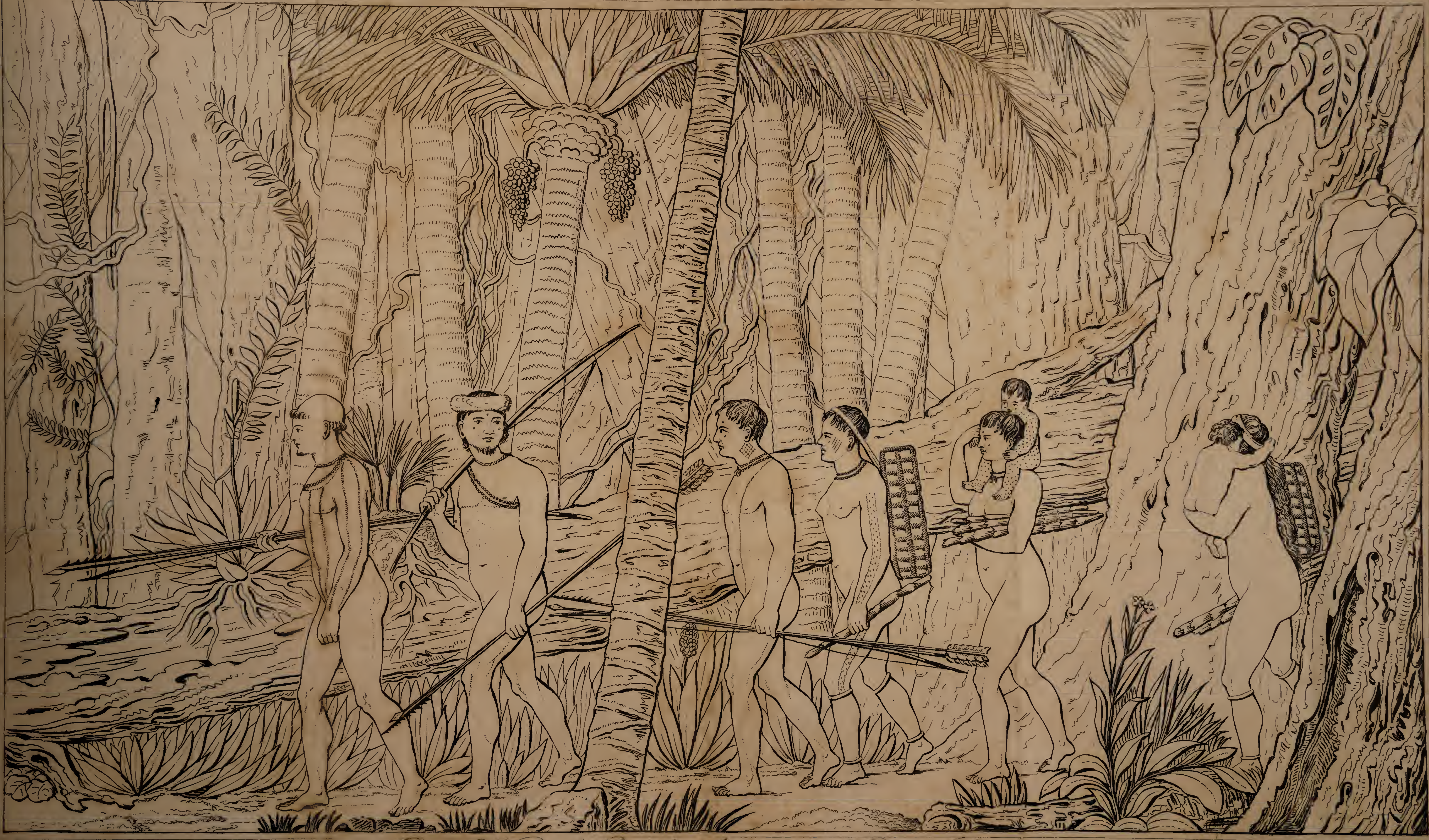
It is not, however, to beauty only that the tropical forests are subservient; they minister copiously to all the uses of human life. In colder climes, a tract covered with wood is a desert; it affords a commodity for trade, but nothing on which its inhabitants can subsist. Among the equatorial forests, on the contrary, there are many trees which produce food almost as abundantly as the most cultivated fields. All the palms distil from their trunk a rich and refreshing juice; the sago palm, distinguished also for its beauty, yields a juice so thick and nutritious, that it is imported into this country and administered as a light and wholesome diet. The bread-fruit-tree and plantain yield a farinaceous fruit, resembling the bread prepared from grain. Thus the equinoctial regions of India, Africa, and the Pacific, even where totally uncultivated, are capable of maintaining a crowded population beneath the shade of their eternal forests.

> ——— Here in eternal prime,
> Unnumber'd fruits, of keen delicious taste
> And vital spirit, drink amid the cliffs,
> And burning sands that bank the shrubby vales,
> Redoubled day, yet in their rugged coats
> A friendly juice to cool its rage contain.

For ship-building, the teak of India appears to surpass even the oak in firmness and durability. The ornamental and dye-woods, mahogany, logwood, camwood, are the exclusive product of this part of the globe. The smaller trees and shrubs are not less rich in valuable products. The warm aromatic plants, as well as those which diffuse the richest fragrance, the cinnamon, the clove, the nutmeg, the myrrh, balsam, and frankincence, spring exclusively in the heart of this favoured zone. Its groves seem regions of fairy land, and the very air is perfumed with fragrance. Yet this lavish display of nature's pomp, of which the equinoctial regions are the theatre, is balanced by evils of no common magnitude. Vast tracts, regions, and almost continents, are condemned, by drought, to a sterility more complete than that which reigns beneath the frozen circle. Under a burning sun, the exuberant fertility of these climates is maintained only by such a profusion of moisture as induces swamp and inundation, with all the inconvenience and insalubrity which attend them. The most luxuriant of the tropical climates therefore are pestilential, and almost fatal to those who are not early enured to them.

What mines of vegetable wealth remain yet unexplored by botanical research! In New Holland, what vast multitudes are there, even now, which the human eye has never seen! How many in Japan and China, the Society and Philippine Isles, Tinian and Juan Fernandez; among the Apalachian and Alleghany mountains; and the glens and recesses of Mexico and Peru, the Andes and the Cordilleras, in the delicious recesses of the Tauridæ; and even of Spain! What myriads also are at the bottom of the ocean, rooted in the plains, recesses, and caves of its bed; with inhabitants to wonder at their calyxes, petals, and corollas; to feed upon their redundancies, and shelter their spawn. Some plants are so large that they rise to the surface, and impede the progress of ships.

The next division of the globe, so far as respects vegetation, may be considered as included between the tropics and the 50th degree of latitude. This last limit at least applies to Europe and Western Asia;—in America it does not reach so high. This climate, without displaying the same bold luxuriance of vegetation, yields in greater abundance most of those commodities which minister to the use and pleasure of man. Within these limits are raised, in their most perfect state, wheat and barley, the grains which yield the most nutritive bread. There almost exclusively are produced the vine, which yields the fermented liquor that is preferred to all others; the olive, subservient to so many agreeable purposes; the mulberry, which affords the means of raising the material, whence the richest article of dress is manufactured. The fruits of this climate, though less substantial than those of the torrid zone, are nearly equal in elegance and flavour. These advantages it obtains, without suffering from that intensity of the heat, or from those prodigious rains and tempests, accompanied by inundation, by which the fertility of the tropical regions is dearly purchased. In this climate, the eye suffer,



W. Read, Sculp.t

Dense Woods of Brazil, with a troop of Puris Indians.

somewhat from the want of verdure, as it exhibits neither the inexhaustible vegetative power which lives in the equatorial forests, nor the almost perennial green of the northern woods and meadows. Its plains have somewhat of a brown and scorched aspect; though, when diversified with hills and rising grounds, the action of the sun on the varied forms of vegetation produces a singularly picturesque and brilliant effect.

Beyond this northern temperate climate, there extends for about 10 degrees another, which bears a character materially different. It comprehends, among many other regions, Britain, a great part of Germany, of Poland, of Russia, and of the United States of America. The luxuriant and elegant fruits and products of the preceding climate cease to grow under this severer sky; they are raised at least only artificially, and in small quantities. But the grains which form the main support of human life may, by the hand of industry, be raised in nearly equal abundance; the pastures are richer, the verdure more constant. Wheat is raised with difficulty in the higher latitudes of this climate; but oats, hemp, and flax, find there the soil most advantageous for their culture. This region is inhabited by an active, enterprising, and industrious body of men; for nature, however productive, when assisted by the art and industry of man, yields in those less favoured countries no spontaneous gifts to the possessors of the soil. The forests, where they are not levelled for cultivation, are fine; the oak, ash, elm, &c. are the prevailing trees. The absence of the exquisite fruits of the preceding climate is not ill compensated by the apple, the pear, the cherry, the strawberry, and gooseberry.

In the climates more remote from the equator, nature assumes a gloomy and severe character. The pines and firs rear their tall heads, and cover the hills with their constant mantle of dark green. Nature, to protect these trees against the external cold, has filled their vessels with a copious internal sap, and when pierced, they pour out, not the rich and delicate juice of the palm and cocoa-nut, but a strong, thick, and glutinous liquid, which, under the titles of tar, pitch, and turpentine, is subservient to many important commercial uses. In favourable situations only, a precarious crop of some coarse species of grain can be raised; and the inhabitants of these ungenial regions are obliged, with the produce of their woods, to purchase the means of subsistence. In proceeding towards the north, every species of vegetation, which can be available to human subsistence, entirely fails; and nothing appears but dwarf trees, the different species of lichen, and a few wild berries.

M. Von Buch calculates, that even at the Northern Cape of Europe, in 70 degrees of north latitude, perpetual snow does not begin till the height of 1060 metres (about 3200 English feet). That able naturalist then gives the following table of the height at which the different plants, which have hitherto stood the cold of this rigorous clime, cease to grow.

	Feet.
The Pine (*Pinus Sylvestris*) - - -	600
The Birch tree (*Betula alba*) - - -	- 1,400
The Myrtle (*Vaccinium Myrtillus*) - -	- 1,850
The Mountain Willow (*Salix Myrsinites*) -	- 1,950
The Dwarf Birch (*Betula nana*) - -	- 2,490

The cold, occasioned by elevation, produces the very same effects on vegetation as those caused by distance from the equator. Forster found, at the foot of Mount Ararat, the plants of Armenia, in its middle height those of France and Italy, at its summit those of Scandinavia. The lichens of Lapland and Iceland appear on the loftiest rocks of the Alps and the Andes, vegetating on the border of their eternal snows. Decrease of temperature, by descent beneath the surface of the earth, seems to operate in the same manner. Humboldt found in the gloomy caverns of the Saxon mines, the same cryptogamous plants which grow on the summit of the highest mountains. See the ENGRAVING.

In St. Jago, palm-trees flourished, indigo plants were healthy, the sugar maple in full verdure; the asclepias gigantea in luxuriant flower; the nux vomica, adansonia, and great fan-palm, flourished vigorously, though little rain had fallen for three years. The camphor-tree suffers little from winds or monsoons; it is indigenous in Borneo, China, and Japan. The cork-tree was first introduced from Barbary into Italy, by Cosmo I. of Tuscany. Cunningham planted peaches, quinces, apricots, and acorns, in the interior of New South Wales, in 1817. D'Ogeron planted cocoa in the island of St. Domingo, in 1656. The wild plum, chesnut, and almond, are indigenous at the Cape of Good Hope. The peach, indigenous in Japan, was, from Persia, first planted in Italy in the time of Claudius. Bauber planted the first cherry-tree and sugar-cane in Caubul. Peter the Great introduced the vine to Astrakan. Baudin brought from Norfolk Island, New Zealand-flax, (previously discovered by Cook), peculiarly valuable, by uniting the useful properties of both flax and hemp. The lily is found in the north-west coast of America, and the warmer parts of Asia; but heath is not known there, though common in Kamtschatka. The papyrus of Egypt, Sicily, on the Congo, and in Madagascar, is not found on the opposite coasts. The blue-berried honeysuckle of Austria, is found in some of the American islands; and that of the Pyrennees also in Canada. The rhododendron is found on the Andes, as well as on Caucasus. In North America is found the superb lily of Japan; and in a glen near Hudson's Bay, are auriculas with purple flowers, and fine green leaves; not mealy, but otherwise similar to those of Norway. Labrador has most beautiful mosses; with wild gooseberries, currants, cranberries, and the raspberries and strawberries of Europe. Spitzbergen affords moss, poppies, scurvy-grass, and ranunculuses. Most Iceland plants are British; yet the spurred violet is indigenous in Iceland and Switzerland. The salix is the smallest of trees: and Dr. Clarke placed within two leaves of a duodecimo volume, twenty specimens found near Christiana, in Sweden; where only, in Europe, grows the American plant, cyprepodium bulbosum. Probably these plants are borne at times by different birds, which let them fall on the parts where such specimens are now found. Only on this hypothesis can we account for their situation and distance in the two hemispheres, and under the same parallels of latitude.

To the circumstance of a shrub being torn up by its roots, do the Spaniards owe the discovery of the mines of Potosi. An Indian, named Hualpa, one day pursuing some deer, climbed over several rocks, down which he was at length in imminent danger of falling. To prevent such accident, he caught hold of a bush; but his weight loosened its roots, and his danger was not diminished; however, he did not fall, but while holding the bush, and viewing the roots, to ascertain how far he might depend on their aid, he was wonderfully surprised by casting his eyes upon a lump of massy silver. Aware of the value of his discovery, he took the treasure to his hut, lived upon its produce some time, and repaired to the same spot whenever he wanted a supply. A neighbour remarking that Hualpa's circumstances improved, and even without any visible means of obtaining subsistence, questioned him so closely, that one day the other revealed his discovery. The two agreed to share between them all its produce, and in this confidence lived some time in social harmony; but happening to quarrel, the confidant betrayed the secret to his master, a Spaniard, residing in the neighbourhood; the mine then became known, and has proved one of the richest in the world.

Besides this general action of the climate on vegetation, there are local peculiarities attached to each region, the origin of which eludes our observation. It appears probable, that all the plants which are now most generally cultivated, and the fruits of which are become necessaries of life over large portions of the globe, belonged originally to a single and perhaps limited tract. Humboldt, indeed, maintains, that the origin of the most valuable grains or fruits cannot now be traced, and that there is no sufficient evidence of their being found wild in any region of the globe. After the most diligent search through the least cultivated tracts of South America, he could not find any trace of the potatoe or banana, unless raised by culture; for the little solitary spots in which they were sometimes found had before been inhabited, though at the time abandoned. Yet we cannot help observing, that all the vegetable productions in question must originally have been produced wild, otherwise it does not appear how they could ever have existed. The northern parts of Britain are the natural country of the oat, and there accordingly the oat is found wild. There may not be any proof of the prevailing report, that wheat and barley are found wild in Southern Tartary; but, at least, there cannot, in our imperfect knowledge of that country, be any proof of the contrary. The same observation may apply to the derivation of the olive from Syria, the nut from Persia, and the vine from the shores of the Caspian. In fact, we see many valuable plants, of which the native country can still be traced, and which either have never endured transportation, or never been raised elsewhere in equal perfection. The coffee-tree is now cultivated, indeed, around all the tropic, but Mocha is undoubtedly the native region, and its produce is still unrivalled. The most precious spices are confined to a few small islands on the eastern side of the Indian archipelago, and have never been transported with success even to the neighbouring large islands, situated under the same latitude, and enjoying apparently a soil equally fertile. Tea is indigenous, and still peculiar to China. The shrubs that diffuse the richest fragrance have always been, and still are, peculiar to a portion of the African coast, reaching from the Straits of Babelmandel to Cape Guardafui. In general, we may observe that it is only a few vegetable luxuries "of nobler taste and more exalted scent" which remain thus rivetted to their original spot, and that the more common and useful species are transplanted without difficulty to every part of the globe that is situated under the same latitude.

In regard to the details of the vegetable species, it clearly appears, that every considerable tract contains at once a number common to it with all others exposed to the same temperature, and also a number of peculiar to itself. The mountains are the great theatre for the display of vegetable varieties, a circumstance which may be traced to the changes of climate that take place in their successive stages, to the comparative absence of human culture, and perhaps, in some measure, to the increased purity and lightness of the air; hence every considerable range of mountains has a *flora* of its own, copious in proportion to its extent, and to the favourable circumstances for vegetation in which it is placed. Every newly-discovered country affords valuable accessions of knowledge to the botanist, and even to the cultivator. Thus Southern Africa, though placed under nearly the same climate with Europe, has contributed to the ornament of our gardens a variety of beautiful flowers that before were unknown. Hence the vast accessions which botanical science received from the discovery of the New World; and others, perhaps not less remarkable, await her in exploring the untrodden mountains that extend through the centre of Africa and of Asia.

These amazing varieties carry us in succession by the most imperceptible gradations from inorganic or mere crystallized atoms, which accumulate by simple accretion, to those which, springing from a germ, live through a cycle of existence; and then having arrived at this class we ascend through the wide range of fixed existences in vegetation, to others, which move, and to move possess senses and perceptions through other infinitely varied gradations till we reach the powers possessed by the head and hand of man.

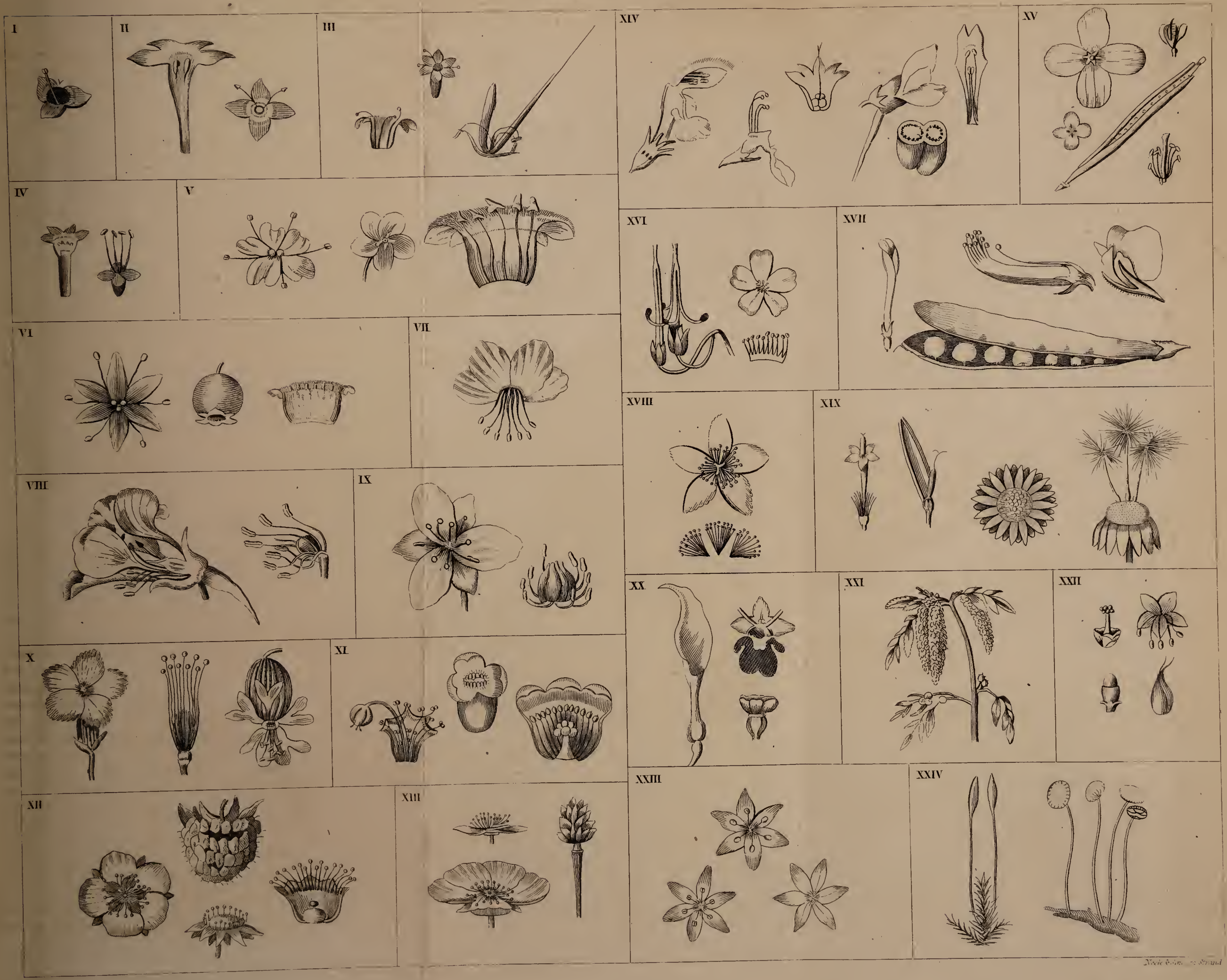
The leaves of plants have been compared to the lungs of animals, upon a few slender analogies; but the additional offices known to be performed by leaves, shew them to be also allied to the digestive and assimilating organs. Possibly the digesting, secreting, excreting, and pneumatic operations of life, may be compatible with each other in the same part; and in some examples, one of those functions may singly belong to leaves, and in other cases many may be associated. The most resemblances between plants and animals are found in those of the most simple structure, wherein the governing influence of physical causes is strikingly obvious; but, under complex organic textures, we are apt to put aside the only natural causes which we are permitted to comprehend, and to attribute the phænomena to an occult cause, known under the ill-defined term, *vitality*. Assuredly, the leaves of vegetables very generally perform the offices of animal stomachs; as when they convert the raw material of vegetable nutriment into a new and peculiar substance, to edify the fabric of plants. The extensive variety of new compounds which different plants contain, are elaborated from nearly the same kind of raw material; and doubtless the vast variety of vegetable leaves is, in each species, adapted to their special secretions.

Plants when growing, may be said to have every object and wish concentrated in themselves and their companions; from the first opening of their corollas, they appear to enjoy all the delights of love, without any of its pains. The season of a flower's conception is that of her beauty; her family she cherishes with delight in the germen; and when she has completed the maturity of her seeds, she finds her consolation in parting with her offspring in autumn, in the pleasure of seeing them start up by her side in the season of spring, images of her own person; expanding their petals, receiving the pollen from their lovers, and becoming mothers in the same manner and in the same season as herself.

The following is the mode by which the roots grow, and produce complete plants:—The seed being deposited in the earth, it will soon obtain sufficient moisture. It has carried with it a portion of air within the husk, which being acted upon by heat, it is probable, that the oxygen of this air is absorbed by the seed, and that carbon is set free. But whatever may be the chemical change effected, the parts act upon each other in a manner similar to the process of fermentation, if it be not absolutely a species of it. The air in the husk, and in the seed itself, being alternately expanded and condensed by the change of temperature, which thus is constantly producing new arrangements, the radicles soon appear: the glutinous part of the seed loses almost entirely its adhesive powers and its elasticity, and dissolves into a sort of pap or starch; which, being constantly acted upon by the change of temperature, and the chemical process induced by such change, the radicles increase their bulk by drawing to themselves this part of the decomposing seeds; for it appears to be admitted by all who have written on the subject, that the matter, which enters into the composition of the radicle of the germinating seed, existed previously in the cotyledons. Most, if not all radicles, at their first appearance, seem, when viewed in the microscope, like tubes of glass, or a very fine transparent membrane, filled with the froth of beer or eggs; with numerous hair-like organs on all sides, generally with small drops of dew in miniature on their points, and hollow at the end adjoining the radicle. The froth is seen as forcing its way into these hairs, and directing their course, not agreeably to the laws of gravitation, but to that quarter which apparently supplies food

THE TWENTY-FOUR CLASSES OF VEGETABLES, ACCORDING TO THE LINNÆAN SYSTEM.

NATURE DISPLAYED.



Neele & Son [illegible] Strand

London. Published by Sir R. Phillips & Co. Feb. 16. 1823.

most congenial to their delicate texture; and where they can be made partly bare and a change of temperature effected, and a motion is perceptible among the air-bubbles. These organs appear to be formed larger or smaller, according as the seed is strong and healthy, or weak and diseased. The plumule now begins to make its appearance in the opposite direction; and the substance of the cotyledons continues to supply the radicles with part of their food, as the dam supplies her young with milk, until they become capable of digesting stronger aliment. Though weak and inferior seeds will germinate, if sound, and throw out radicles; yet these radicles frequently decay and disappear, before the influence of the soil has any visible effect on them; which appears evidently to be on account of the small quantity of nourishment originally contained in the seed. Or if the radicles do lay hold of the soil in the same degree, yet from the defective nourishment supplied by the seed, they will most likely decline and die. To use inferior seed therefore is injudicious, as it is often fatal to the expected crop. But when the seed is good, by the time the cotyledons are exhausted, the radicles will have laid hold of the ground sufficiently to support themselves, and the plumule will have risen above the surface. This part likewise is cellular, and amply furnished with air-bubbles, which are constantly acted upon by the change of temperature.

They are, properly speaking, the *hybernaculum*, or winter quarters of the bud of the plants, which may be propagated by these bulbs as well as by seeds.

There are four sorts of bulbous roots:

1. Squamous; having scales laid over each other like tiles, as the lily.
2. Solid, as in tulips.
3. Coated; with many coats, infolding each other as onions.
4. Cauline; produced not only from the sides of the principal bulb, but also from other parts of the stem.

Tuberous roots are solid and hard, containing one or more embryos, or eyes. Some have one eye at the top, as the turnip, carrot, radish, parsnip; others have many knobs connected together by fibres, as the potatoe and Jerusalem artichoke, and containing many eyes dispersed over the surface, either depressed like the potatoe, or raised like the Jerusalem artichoke.

Grafting of trees is taking the branch of one tree, and applying it nicely to a branch or trunk of another tree, when they will grow together, and the branch will afterwards flourish, retaining all the qualities of the tree from which it was taken.

These methods are thus described by Virgil, as translated by Dryden:

> Some trees their births to bounteous nature owe;
> For some without the pains of planting grow.
> With osiers thus the banks of brooks abound,
> Sprung from the watery genius of the ground.
> From the same principle grey willows come;
> Herculean poplar, and the tender broom.
> But some from seeds inclos'd in earth arise;
> For thus the mastful chesnut mates the skies.

Hence rise the branching beech and vocal oak,
Where Jove of old oraculously spoke.
Some from the root a rising wood disclose;
Thus elms, and thus the savage cherry grows.
Thus the green bay, that binds the poet's brows,
Shoots, and is shelter'd by the mother's boughs.
These ways of planting, nature did ordain,
For trees and shrubs, and all the Sylvan reign.
Others there are, by late experience found:
Some cut the shoot, and plant in furrow'd ground;
Some cover rooted stalks in deeper mold:
Some cloven stakes, and (wond'rous to behold),
Their sharpen'd ends in earth their footing place,
And the dry poles produce a living race.
Some bow their vines, which bury'd in the plain,
Their tops in distant arches rise again.
Others no root require, the labourer cuts
Young slips, and in the soil securely puts.
Ev'n stumps of olives, bar'd of leaves and dead,
Revive, and oft redeem their wither'd head.
'Tis usual now, an inmate graff to see
With insolence invade a foreign tree.
Thus pears and quinces from the crab-tree come;
And thus the ruddy cornel bears the plum.

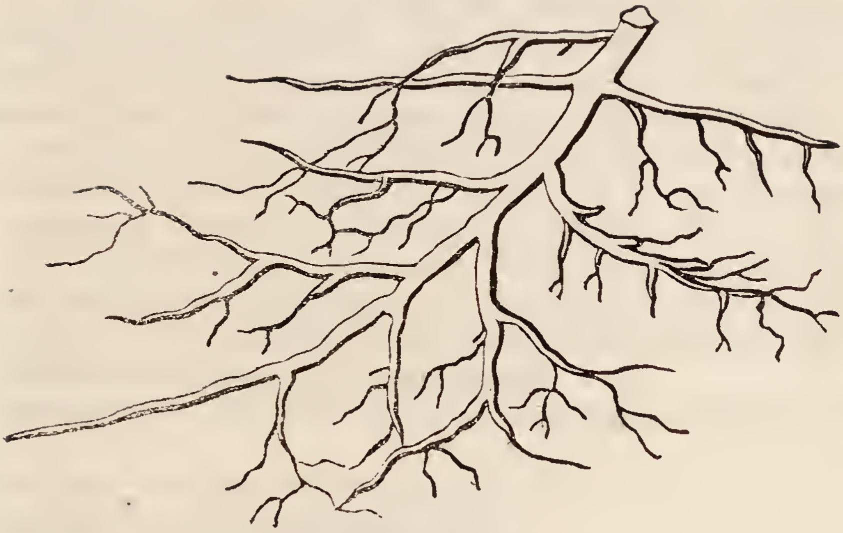
The inoculation of trees is an operation performed on all sorts of stone-fruit, as nectarines, peaches, cherries, apricots, and plums. It is cutting the bud out of one sort of tree, and inserting it in another, to which it joins itself. The same advantages are obtained as from ingrafting.

Inoculating plants is thus described by Virgil, as translated by Dryden:

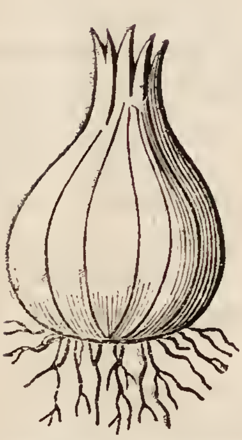
But various are the ways to change the state
Of plants, to bud, to graff, t' inoculate.
For where the tender rinds of trees disclose,
Their shooting gems, a swelling knot there grows;
Just in that space a narrow slit we make,
Then other buds from bearing trees we take.
Inserted thus, the wounded rind we close,
In whose moist womb the admitted infant grows.
But when the smoother bole from knots is free
We make a deep incision in the tree;
And in the solid wood the slip inclose
The battening bastard shoots again and grows
And in short space the laden boughs arise,
With happy fruit advancing to the skies.
The mother-plant admires the leaves unknown,
Of alien trees, and apples not her own.

The Chinese produce dwarf-trees by applying clay to the branch of a tree bearing fruit, and when after a time the branch has thrown out roots through the clay, they then cut it off a little lower down, and remove it into a flower-pot.

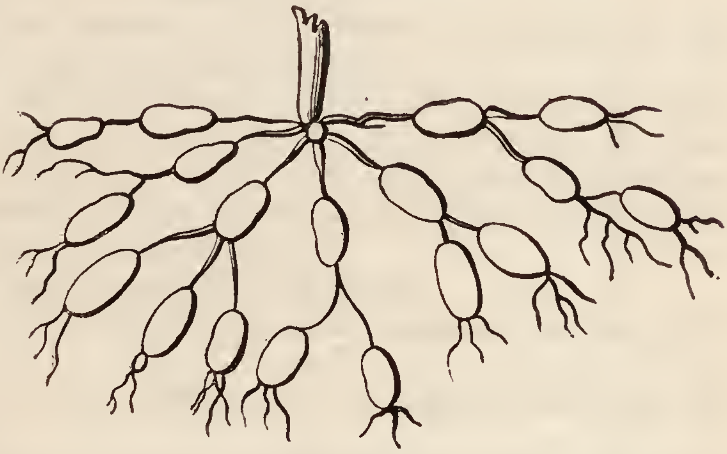
ROOTS.



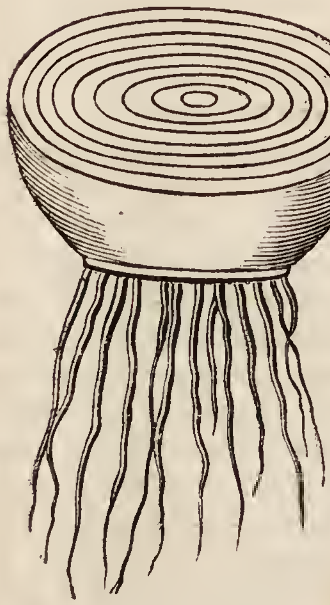
Branching.



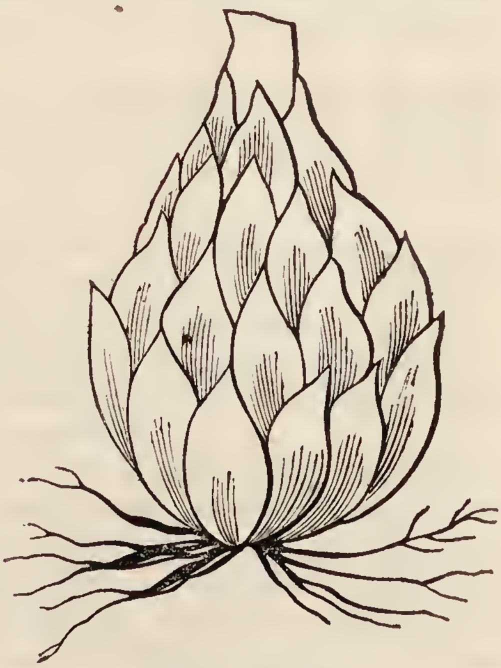
Solid Bulb.



Tuberose.



Coated Bulb.



Scaly Bulb.

Three Engravings, containing Mrs. Ibbetson's Microscopical Observations on Vegetation.

THE late Mrs. Agnes Ibbetson, of Devonshire, distinguished herself during many years by the most elaborate researches in vegetation, made with microscopes of extraordinary powers. She published her observations in a long series of papers in Nicholson's Journal and the Philosophical Magazine, accompanied by engravings, *from which we have made a selection of the most remarkable objects*, and for a description of which we refer to the list of plates. It will be seen by them, that many things connected with vegetation, not more than the thousandth part of an inch in length, are here enlarged to the dimensions of a full inch, and the most wonderful processes are rendered conspicuous.

The principles which Mrs. Ibbetson seeks to establish, are as follow:—

1. *That there is no perspiration in plants.*
2. *That there is no circulation of sap.*
3. *That the spiral wire is the muscle of the plant.*
4. *That the leaves are the lungs of the plant.*
5. *That the different divisions of the leaves are formed of the elongations of the bark and inner bark-vessels.*
6. *That the hairs and instruments of that kind are the means which Nature takes to form the different juices according to their various affinities. That these forms were taken for perspiration, but are in reality liquids received from the atmosphere and flowing into the plant, not a juice running from it.*
7. *That the root is the laboratory of all plants.*
8. *That the heart of the seeds is formed in the extremities of the side-roots.*
9. *That the flower is also formed in the middle root, and the pollen in the tap root.*
10. *That the corolla of a flower is formed by bubbles of water placed in rows, and owes all its beauty, and the lightness of its tint, to the refraction and reflection of the sun on the drops of water which form its pabulum.*
11. *That the roots and leaves of a plant will most exactly mark not only what is the soil in which they originally grew, but the situation from which they came, whether a water plant or a dry plant, a rock or a valley plant, &c.*
12. *That the water, and semi-water, and rock plants alone, can be said to have direct air-vessels, though she has found them in parasite and early spring plants, such as the crocus and hyacinth.*
13. *That the leaf owes all its mechanism to the gatherer alone.*

In her numerous papers she elicits the following interesting conclusions, amidst a vast body of reasoning.

Trees and shrubs receive little nourishment from the atmosphere, as their roots alone afford them plenty. Evergreens absorb none; herbaceous and annuals gain much support from rains and dews. Bog plants little in this way, and are therefore more hurt by a change of situation than any other, except water plants; because their leaves receive no indemnification for the loss of food by their roots. Sand-plants receive much support from the atmosphere; and rock-plants are wholly fed by it; the leaves of firs are incapable of receiving moisture, the cuticles being too much like evergreens, and too well guarded to admit it.

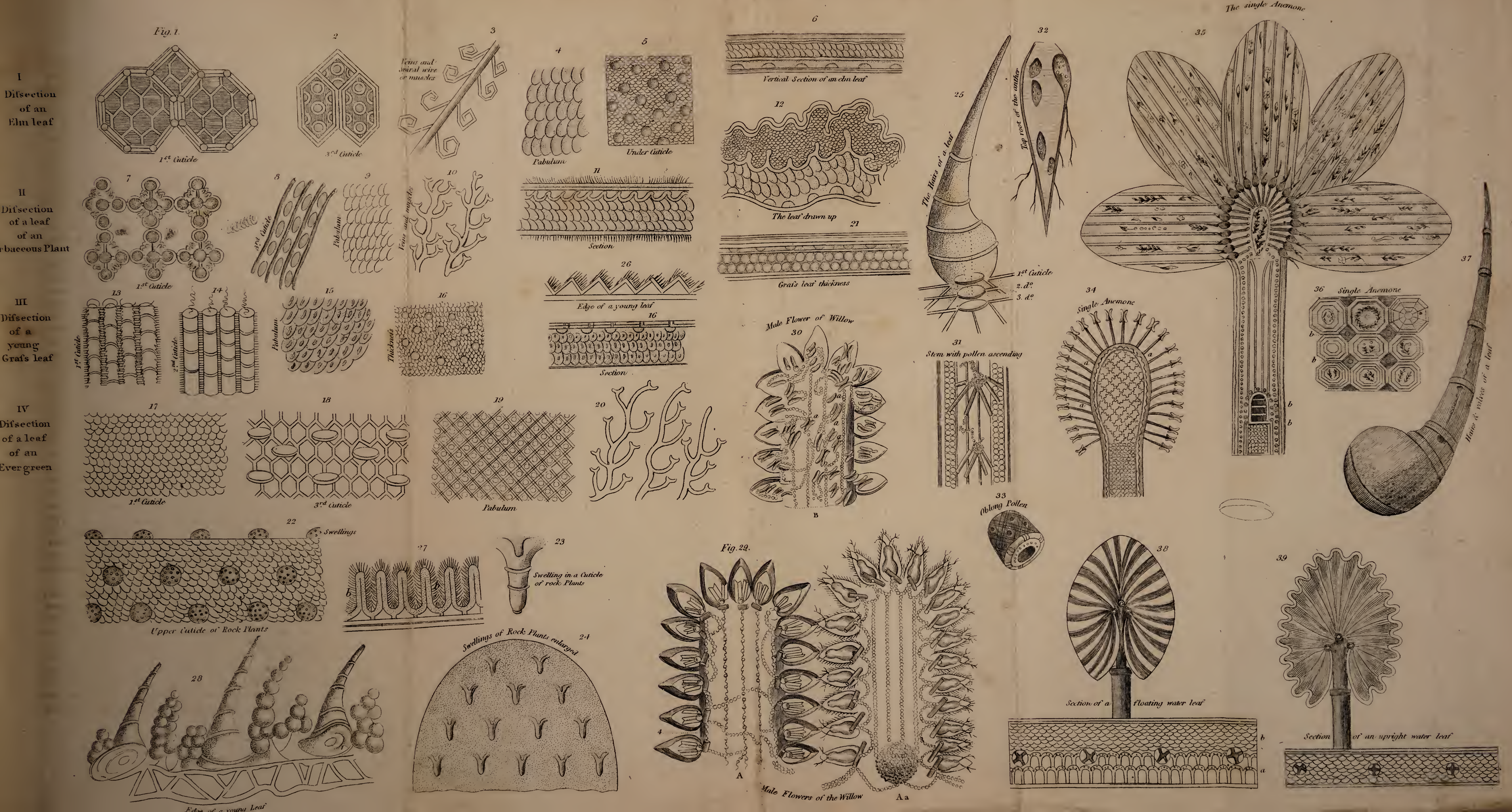
The leaves of trees and shrubs consist of three upper cuticles and two under; the under cuticle is impervious to water, the next is a net with bladders, placed alternately high, which keep the cuticle hollow from the pabulum; these bladders are very succulent, and cannot therefore bear the heat; nor can the cuticle, though hollow and dry, support exposure to the sun, without being liable to peel off, tear, and break: hence, when once the leaf is dried, it never turns its back to the sun. Next comes the pabulum, thick or thin, in proportion to the leaf; for the increase of this part alone thickens a leaf. On each side are the veins containing the spiral wire: then the three upper cuticles, the impervious one being in the middle.

The hairs, and those instruments taken for perspiration, bring moisture to the plants, instead of withdrawing it; and there exists a skin impervious to water over all leaves and most other parts, and of peculiar use to water-plants. Though leaves and the parts under water uncovered by vails, want hairs, the flowers which shoot their spikes above, and the buds while thoroughly defended from the stream, have a few filled with water. The bud, before the flower develópes, is covered by a treble vail, so thoroughly impervious to water, that one is usually inflated with air, more effectually to guard the pollen, and resist moisture.

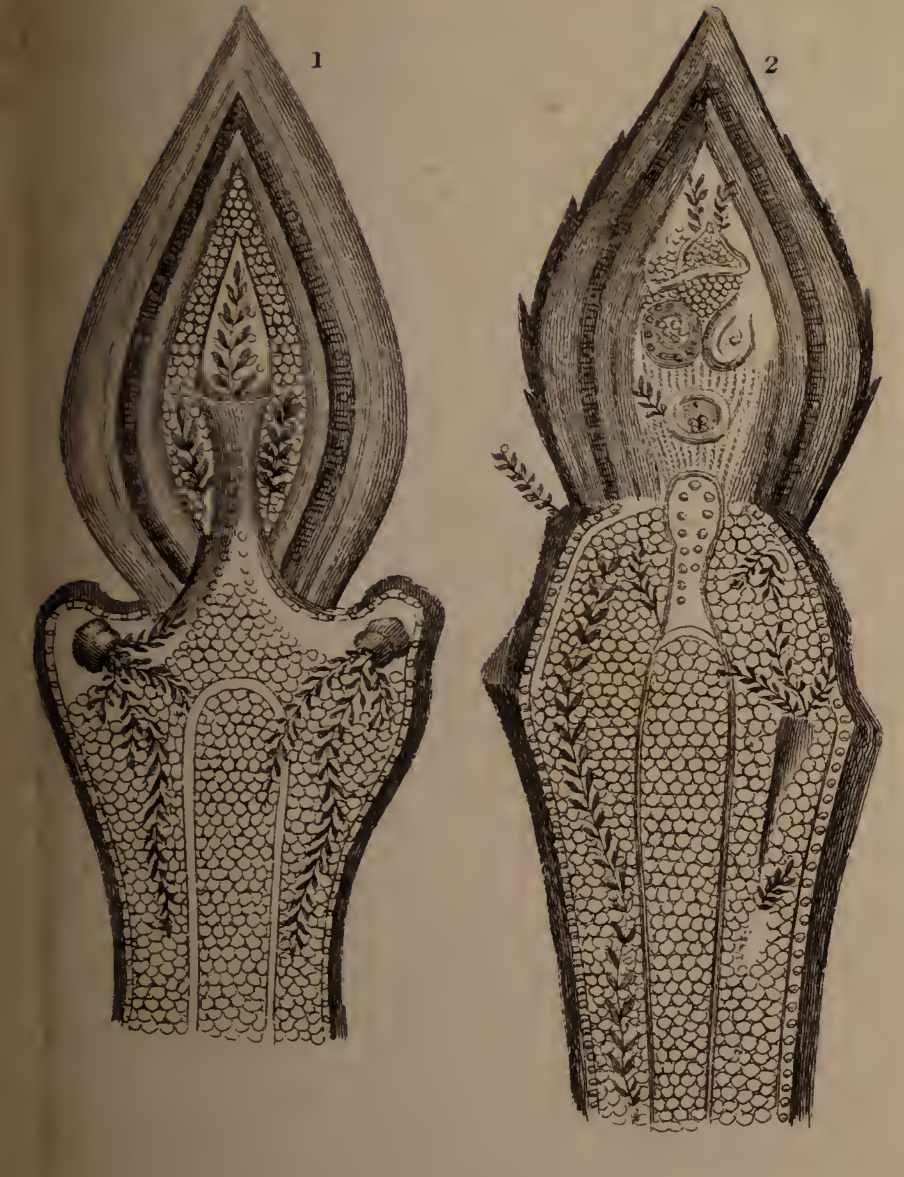
Evergreens receive no moisture from the atmosphere. Besides their impervious outward cuticles both above and below, they are so guarded over the pabulum by a thin layer of bark juices, and air-bladders, that no moisture can approach them in that direction. They have five upper, and three under cuticles, so closely pressed together, as apparently to form but one; of the second cuticle, those with scented leaves have bladders of an oily compound; this evidently enters from the atmosphere, and thus are all leaves scented, the perfume being kept distinct from the other juices. Like most other plants, evergreens, when first shooting, have many hairs. The extreme shining of the upper cuticle is caused by the glutinous matter, which fills up, like oil, the network of the exterior one, and renders it perfectly lucid; and this hard and stiff skin, and the bladders of inflammable air, cause it to explode in the fire; and the glutinous cuticle protects it from the cold of the winter.

All grassy leaves of spring have a peculiar formation; they receive little moisture from the atmosphere. The crocus, snowdrop, hyacinth leaf, &c. are filled with a glutinous liquor in their pabulum, which protects them from the early frosts; they have three cuticles above and three below; the upper ribbed like a grass leaf, and carrying in stripes the spiral wire; and the pabulum is in pockets, and at a great distance, while the cuticles are merely longitudinal vessels, differing from the gramina only by having a pabulum: they have three scolloped cuticles on each side, and have no veins, their place being supplied by the exterior cuticle

Mrs. Ibbetson's, Microscopical observations on Plants.



Sections of Buds, and contained Flowers.



Buds ascending.

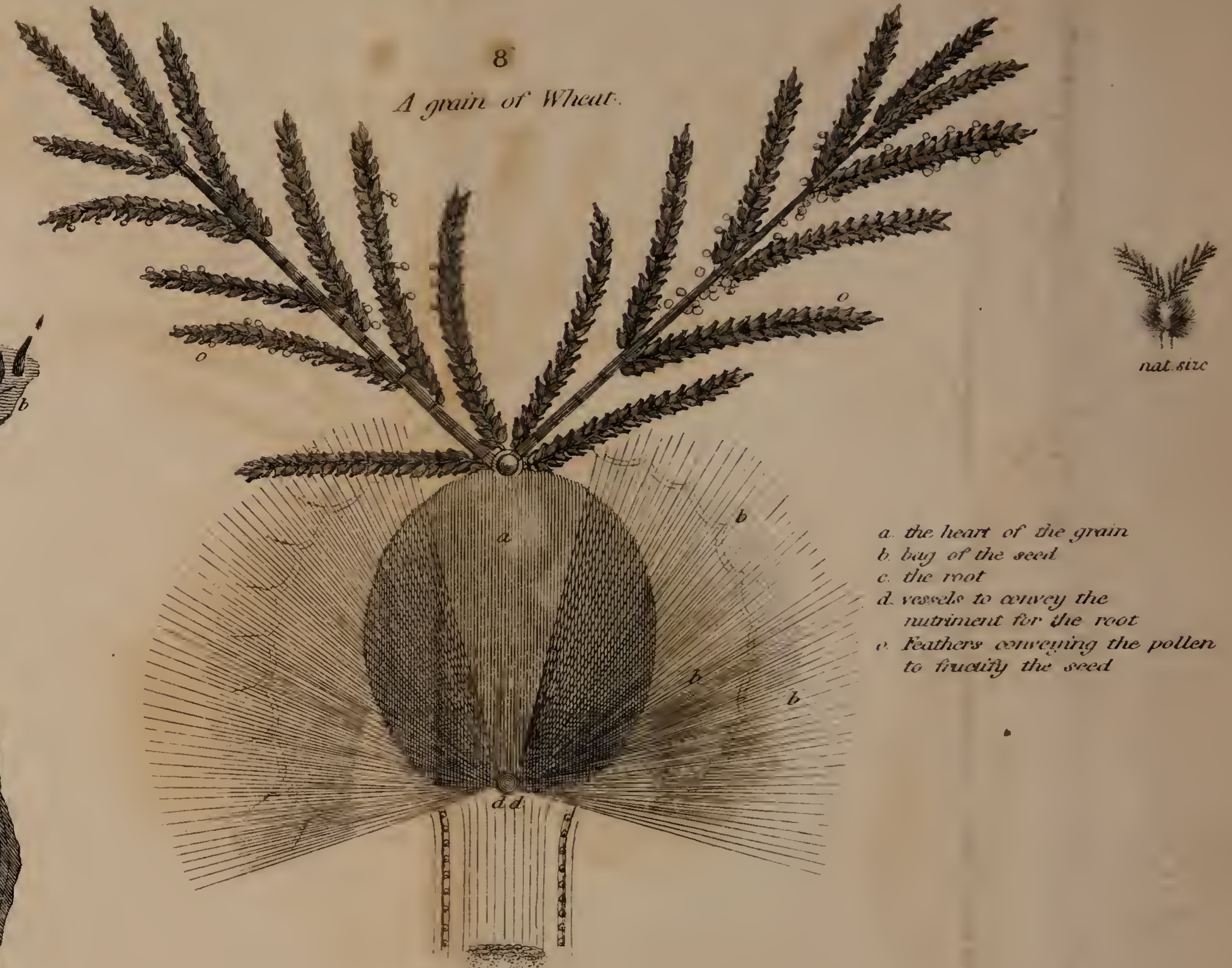
d.d. Flower-buds germinating

Flower-buds magnified.

a. covers of the buds

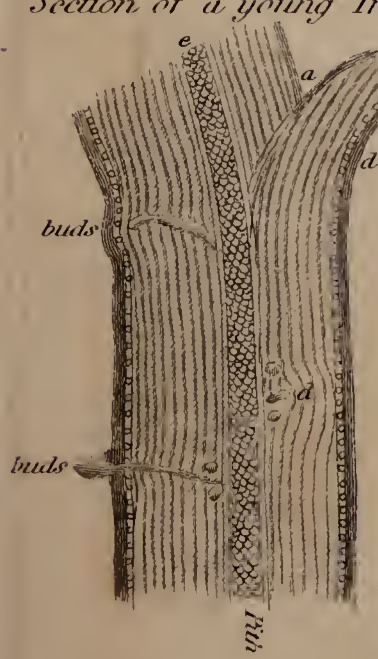
b.b. buds approaching the bark

A grain of Wheat.



a the heart of the grain
b bag of the seed
c the root
d. vessels to convey the nutriment for the root
e Feathers conveying the pollen to fructify the seed

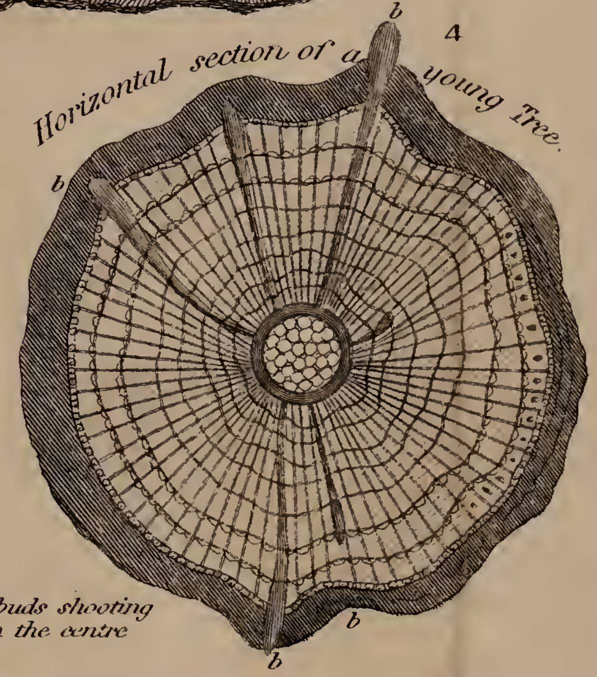
Section of a young Tree.



New shoots and arrangement of the buds.

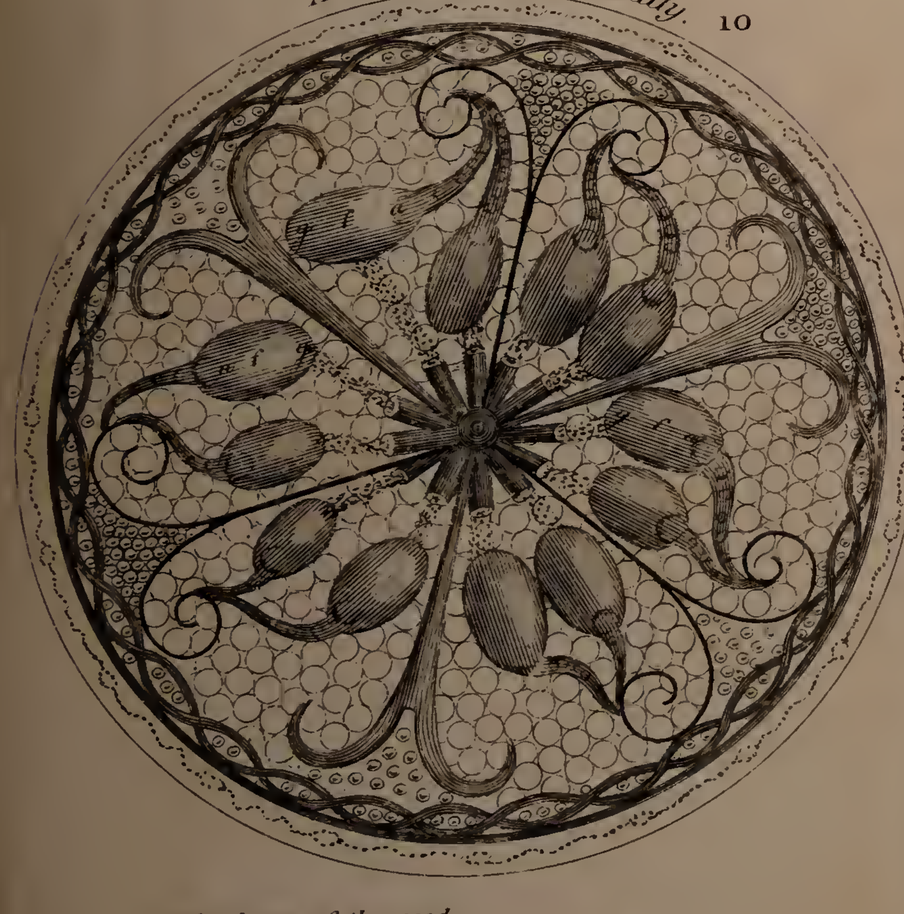
Ball or heart of a seed.

Horizontal section of a young Tree.

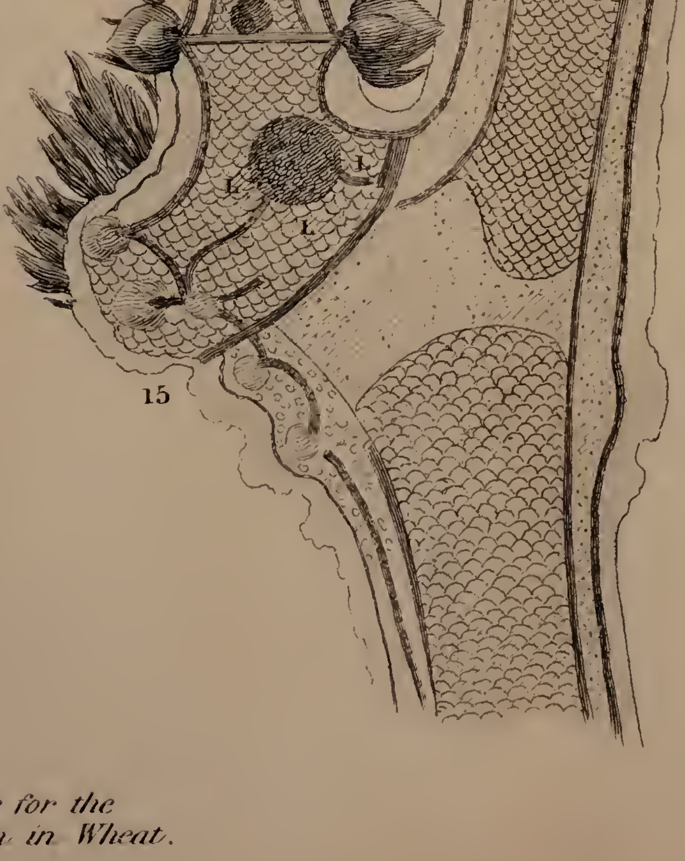


b.b. buds shooting from the centre

A Gourd cut horizontally.

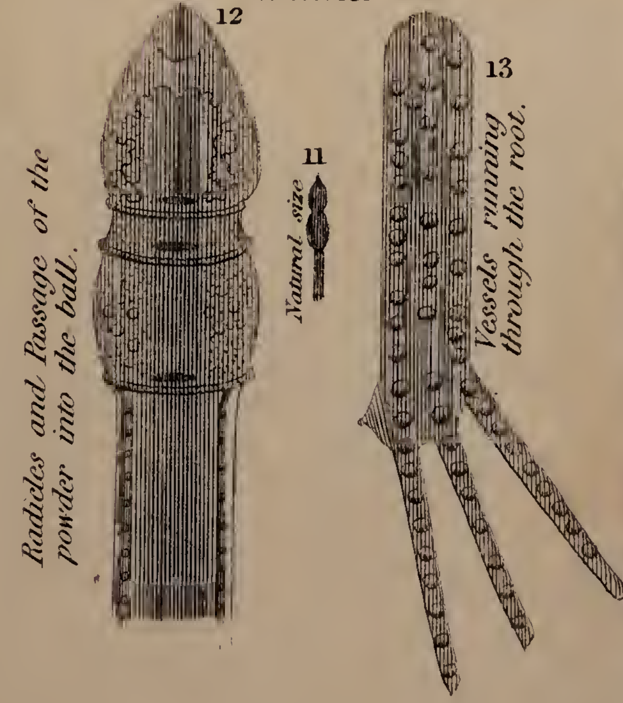


a. the heart of the seed
f. vessels containing the heart of the seeds
g the powdered nutriment



Vessels of the Feather for the reception of the Pollen in Wheat.

Radicles

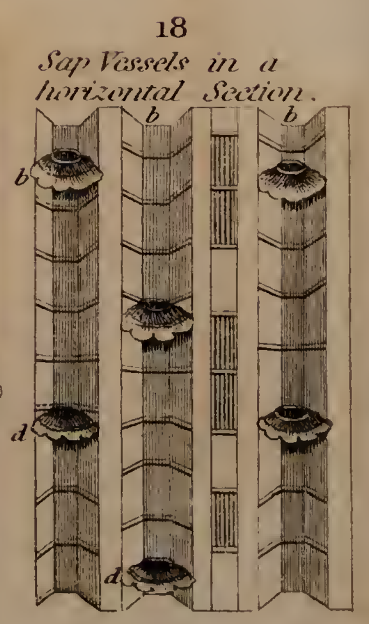


Radicles and Passage of the powder into the ball.

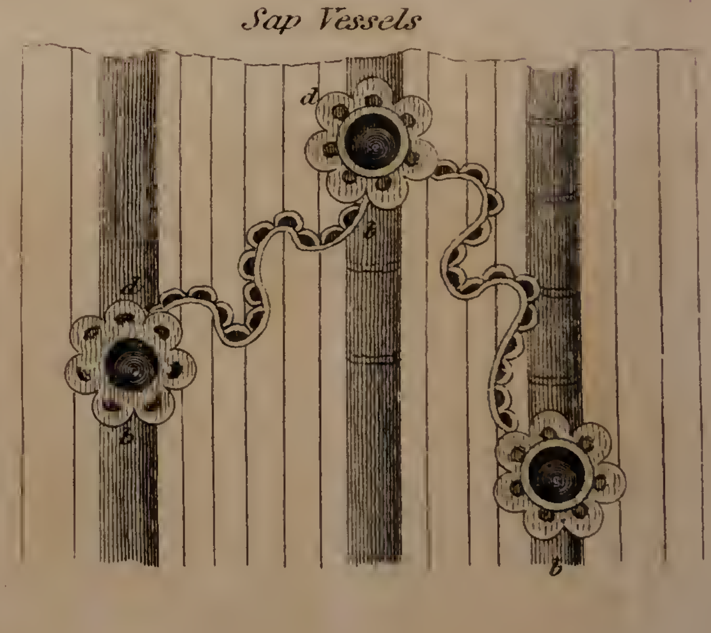
Vessels running through the root.

Formation of a new shoot.

Sap Vessels in a horizontal Section.

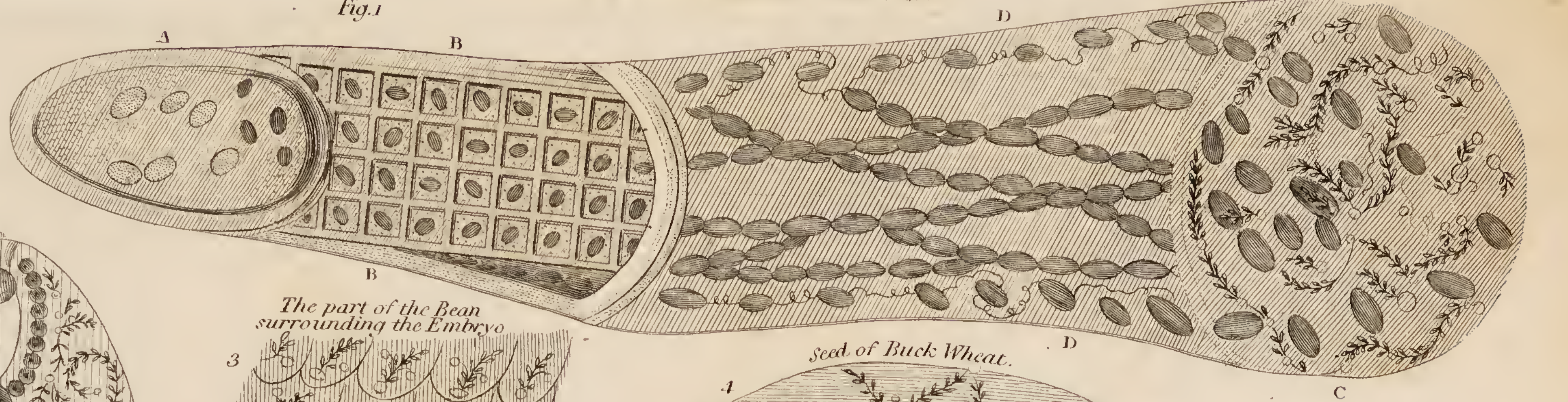


Sap Vessels

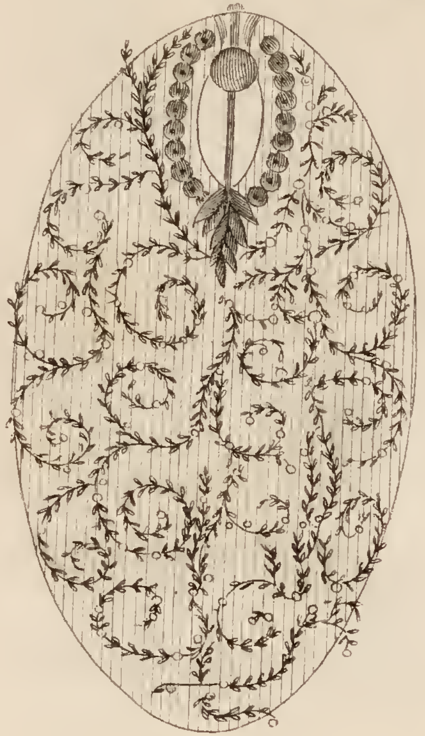


Fresh grown radical of the Iris.

Fig. 1



2



Seed of the Melon after fructification.

The part of the Bean surrounding the Embryo

3

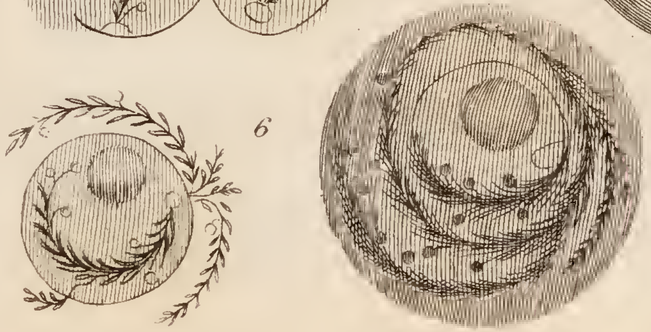
Seed of Buck Wheat.

4

5

Interior of a Pea before fructification

6



Heart of the Seed of the Fir germinating.

7

Heart of the Fir Seed.

London Published by Sir R. Phillips & C°. Feb. 10. 1823.

Neele & Son 352 Strand

The bark-juice is composed from the leaves, to which the juices, taken by the hairs of the leaves from the atmosphere contribute; and when the pabulum is completed, the remaining juices flow in large vessels from the leaf-stem to the bark. The sap has two ways of flowing; the one is up the alburnum vessels, which run up the tree, a whole week or more, twice in the year, called the barking time, because, in running between the bark and wood, it detaches one from the other, and in separating, allows time for the sap to coagulate and form a new row of wood; while the sap also pushing back the bark, prepares a fresh row of alburnum, allowing the wood-vessels to lengthen, and by thus increasing runs through the new wood. At this time a large collection of sap is always at the bottom of the root, serving as a reservoir for the alburnum, plainly showing, that this ascension of the sap is managed by a different law from the flow of the sap in the wood, since that has no reservoir below. The other flow is up the wood-vessels, in a constant rill, much quickened, however, in the morning or evening; but continuing through the year.

The spiral wire is the muscle of a plant, and acts on and for the plant, exactly as the independent muscle does for the animal body; Mrs. Ibbetson draws up the physical resemblance, showing how accurately and perfectly every part suits. First, muscles are, to the animal body, the strength of motion. Like the wood of the vegetable, the bone may claim to support the figure; but the muscle is the only source of real strength in both. Wherever strength and motion are required, there is the muscle found; and wherever strength and motion are requisite in the plant, there the spiral wire is discovered.

The vegetable has neither brain nor nerves, hence could not have any voluntary motion; but it possesses, in a very superior degree, that involuntary motion discovered in animals; that motion called the vis insita of the muscles, belongs to no other part; which, when the muscle of an animal is completely divided from every other ingredient, will agitate it for a time. The cause of this vis insita in animal muscles is unknown; but, in the spiral wire, light and moisture certainly act on it; for the moment it is exposed to the light, especially after being detained some time in the dark, its motion is excessive, though perfectly inert before. Nay, on placing an animal muscle in one slider, and a spiral wire in another, they have both, on being presented to the light, moved much; but the vegetable spiral infinitely more than the animal muscle.

Certain flowers have the power of defending their secret nectary by closing. Insects are often found thus confined. The muscle thus contracting from the heat of the insect's body, is quite sufficient to influence a spiral wire, though perhaps not a thermometer. —The force of the spiral is not only great in the flower, but greater in the leaf, as the whole health of the plant depends on the constant motion of the leaves of the trees; but the constant motion in which the spiral wire keeps them, produces a constant change in the air around each tree. All the mechanism of the leaf is managed not only by the same stripes as the petals, but by the mechanical contrivance of the leaf-stalk; the gatherer on each end of the peduncle being the chief source of motion in the leaves. Those plants that do not move their leaves have no spiral wire, as the firs, lichens, sea-weeds, &c.; but the confervas, that move like a worm, and twist in every direction, are like the tendrils, composed almost wholly of muscles. If a few of the spirals are taken out of the peduncle, the leaf turns no more: but if taken out of the tendril, it becomes perfectly inert:—but the spiral taken thence, moves in the microscope for hours.

The fructification of seeds is, the conveying the powder of the pollen, when dissolved in the juices of the pistil, down to the seeds, allowing each vessel to enter each different seed, and bestow its quantum of matter on all by turns. This takes place as soon as the seed has received all its nutriment; and differs so much from the subsequent process, that there is no fear of confounding them. This last operation takes place as soon as the flower is full blown, and therefore at full perfection.

The pistil receives and reduces the flower of the pollen, which clings to it, and then carries the mixt juice down to the little branch in the heart of the seed, vivifying and exciting its growth.

The flower, however various in appearance, invariably has its summit and style above the seed-vessel, and these parts in one connected pillar with the secret nectary; while the open nectary is always at the exterior of the pillar, perfectly aloof. The stamens may seem united with the pistil, but they are ever fastened to a skin connected with the cylinder below, that carries the vessels of the stamen to the wood part, and only lies against the pistil. The pistil is then connected with only those parts mentioned. The stamens when ripe throw their pollen by many different methods on the stigma. The forms of the pistil evince that it was made to receive, secure, and dissolve the pollen.

The regular process seems as follows:—the heart of the seed mounts with its germ from the root, where it takes it in, into the seed-vessel, and proves itself the seed, not only by its whole progress to fructification, but by having the same germ in the heart it afterwards displays spreading from the primordial branch all around the embryo, after the seed is fructified: and thus, when the seed is fit to place in the ground, not only the embryo but the female flower is also fitted for its increase, and fixes, by the various germs in the seed, the beginning stripe for each line in the wood. —The flower, therefore, the cor and pericarp, is continued from plant to plant, while the male is renewed and reproduced yearly in every tree. This accounts for the bark and pollen in a graft never joining, while every other part strictly assimilates. This proves, also, that the stripes of flowers in the wood were formed, not the year they appear at the exterior of the plant, but the preceding: indeed, the appearance of the two is so dissimilar, not only in form and size, but in situation also, that it is impossible to take them for each other; the first being simply in stripes, but those which are to open the present year, both in trees and herbaceous plants, are discovered not only larger, but in all sorts of festoons, wreaths, and bouquets, making the richest and most beautiful patterns.

LECTURE LXXV.

ON BRITISH FOREST TREES.

Welcome, ye shades! ye bowery thickets, hail!
Ye lofty pines! ye venerable oaks!
Ye ashes wild, resounding o'er the steep!

THOMSON.

THE OAK.

The lofty oak, whose vigorous branches form
An ample shade, and brave the wildest storm,
High o'er the subject wood is seen to grow,
The guard and glory of the trees below;
Till on its head the fiery bolt descends,
And on the plain the shatter'd trunk extends:
Yet, then, it lies majestic as before,
And still the glory, though the guard no more.

CRABBE.

THE oak, the monarch of the forest, stands at the head of British timber-trees, on account of its utility and majestic figure. It grows to such a surprising magnitude, that were there not many well-authenticated instances of them in our own country, they would certainly appear incredible.

In 1775 an oak was felled at Woodhall, which sold for 43*l.* and measured 24 feet round. Hunter's Evelyn's Sylva gives an account of a very remarkable oak at Greendale, which Gough, in his edition of Camden, thus minutely describes: "The Greendale oak, with a road cut through it, still bears one green branch. Such branches as have been cut or broken off, are guarded from wet by lead. The diameter of this tree at the top, whence the branches issue, is 14 feet 2 inches; at the surface of the ground 11½ feet; circumference there 35 feet; height of the trunk 53; height of the arch 10, width 6."

A species, differing essentially from the common one, is frequent about St. Thomas, in Devonshire, and in that county called Lucombe oak, from one William Lucombe, who successfully cultivated it, near Exeter. It grows straight and handsome; its leaves are evergreen, and its wood as hard as that of the common oak. Its growth is so quick, as to exceed in 20 or 30 years the altitude and girth of the common one at 100.

Du Hamel gives an account of an oak he had kept in water eight years, and which yielded fine leaves every spring. The tree had four or five branches; the largest 19 or 20 lines round, and more than 18 inches long. It throve more in the two first years than it would have done in the best earth; it afterwards lost its vigour, and decayed; which he attributed to a defect in the roots rather than to want of aliment.

The English oak, however, claims precedence as a timber-tree, for the height and bulk, and superior worth of its wood. It is remarkable for its slow growth, bulk, and longevity. The trunk sometimes attains the size of only 20 inches in diameter in fourscore years. Lord Powis possessed an oak, in 1764, growing in Broomfield-wood, near Ludlow, in Shropshire, whose trunk measured 68 feet in girth, 23 in length, and which, reckoning 90 feet for the larger branches, contained in the whole 1,455 feet of timber, round measure, or 29 loads and five feet, at 50 feet to a load.

Many suppose the Cowthorp oak, near Wetherby, in Yorkshire, to be the father of the forest. Within three feet of the surface it measured 16 yards, and close to the ground 26. In 1776, though in a ruinous condition, it was 85 feet high, and its principal limb extended 16 yards from the bole. The foliage was very thin. If this measurement were taken as the dimension of the real stem, the size of this tree would be enormous; but, like other very large trees, its stem is short, spreading wide at the base, the roots rising above the ground like buttresses to the trunk, which is similar not to a cylinder but to the frustum of a cone. In the principal dimensions, the size of the stem, it is exceeded by the Bentley oak. In 1759, in Holt forest, near Bentley, was at 7 feet, 34 feet. In 1778, this tree was increased half-an-inch in 19 years. These dimensions are exceeded, however, by those of the Boddington oak. It grew in a piece of rich grass land belonging to Bodington Manor-farm, near the turnpike-road between Cheltenham and Tewkesbury, in the vale of Gloucester. The stem was remarkably collected at the root, the sides of its trunk being more upright than those of large trees in general; and yet its circumference at the ground was about 20 paces and more than 18 yards. At 3 feet high it was 42 feet, and where smallest, *i. e.* from 5 to 6 feet high, it was 36 feet. At 6 feet it swelled out larger, and formed an enormous head, which was furnished with huge, and probably extensive, arms. But time, and the fury of the wind, robbed it of its grandeur, and the greatest extent of arm in 1783 was 8 yards from the stem.

An oak tree was felled in April, 1791, in the Park of Sir John Rushout, Bart. at Northwick, near Blackley, in Worcestershire, judged to be about 300 years old. It was perfectly sound. In Mr. Gilpin's work, entitled Forest Scenery, there is an account of oak trees in the New Forest which had marks of being trees before the Conquest. The tree in the same forest against which the arrow of Sir Walter Tyrrell glanced and killed King William Rufus, remains still a tree, though much mutilated. In Mr. Robert Lowe's View of the Agriculture of Nottinghamshire, several trees are said to have been lately felled in Sherwood Forest, which were found to have cut into them J— R. or Jn. R. (*Johannes Rex.*) and some had a crown over the letters.

In 1794, an account was given of an oak in Penshurst-park, Kent, called the Bear or Bare oak, (supposed to resemble that which Camden thought gave name to the county of Berkshire.)

OAK

POLLARD OAK

The tradition is, that it is the tree planted on the day the celebrated Sir Philip Sydney was born. It was cut down some years ago; and Sir John Cullum was of opinion that its antiquity was still greater. This fine old oak stood upon a plain about 500 yards from their venerable mansion, near a large piece of water called Lancup-well. Ben Jonson and Waller have particularly noticed it; and, from the distinguished owners of this place, it may be truly said to stand on classic ground.

The oak thrives most in a rich strong soil, hilly rather than boggy, and flourishes best in large plantations. As it is injured by cropping, great mischief is annually done to it by cutting off large branches to celebrate the 29th of May.

From the earliest records of history, the oak has been an object of veneration. One of the laws of the ten tables regulated the gathering of acorns, even though they should have fallen into another man's grounds. "The land and sea," says Evelyn, whose observations are equally curious and original, "do sufficiently speak for the improvement of this excellent material. Houses and ships, cities and navies, are built with it; and there is a kind so tough and so compact, that the sharpest tools will hardly enter in, as scarcely the very fire itself, in which it consumes but slowly. Acorns were heretofore the food of men, as well as other productions of the earth, till their luxurious palates were debauched; and even in the time of the Romans, the custom in Spain was to make a second service of acorns and masts, as the French do now of marrons and chesnuts, which they likewise used to roast under the embers." Almost every part of the oak has an appropriated use. The bark is employed for tanning leather. The balls or apples are excellent substitutes for galls; but the black which they produce, although more beautiful, is not so permanent as that of the foreign galls. The oak-balls, which in autumn diversify the surface of the leaves, are produced by a small insect, the *cynips querci folii*, which, to deposit eggs in the substance of the leaf, makes a small perforation on the under surface. A ball, occasioned by the unhealthy circulation of the sap, begins to grow; the egg in the centre changes to a nymph; the nymph to a flying insect with four wings. Kirby and Spence state, that the *cocus illicus* found on the evergreen oak, in the South of France, was used in the earliest ages for dyeing a red-blood or crimson, and was known to the Phœnicians before the time of Moses.

But from the utility of its wood, the oak acquires its chief fame; especially its adaptation for the important purpose of ship-building. This makes it peculiarly the favourite of England, to whose naval glory it has materially contributed. Thus Pope, speaking of vegetable treasure, says,

Let India boast her plants, nor envy we
The weeping amber and the balmy tree,

While by our oaks the precious loads are borne,
And realms commanded which those trees adorn.

Its suitability for this purpose is by its strength, durability, and the property of not readily splintering; the latter of much importance since the invention of cannon.

Evelyn, who may be styled the father of English gardening, passed much of his time in planting oaks, and improving his family estate at Wotton, in Surry. In his *Sylva*, he describes the timber on that estate to be worth 100,000*l.* and mentions an immense table of oak, and a solid piece of beech 6 feet in diameter, which were grown in the Wotton woods. Bishop Watson, in his Memoirs, says, " A 74-gun-ship takes 2,000 trees of 2 tons each, and supposing 40 such trees growing on an acre, clean 50 acres of wood-land. Supposing that the navy, for the construction of new ships and the repair of old ones, would require ten times that quantity annually, 500 acres would supply the annual consumption, and 50,000 acres would supply the demand for ever, if trees of 100 years growth are large enough for navy timber."

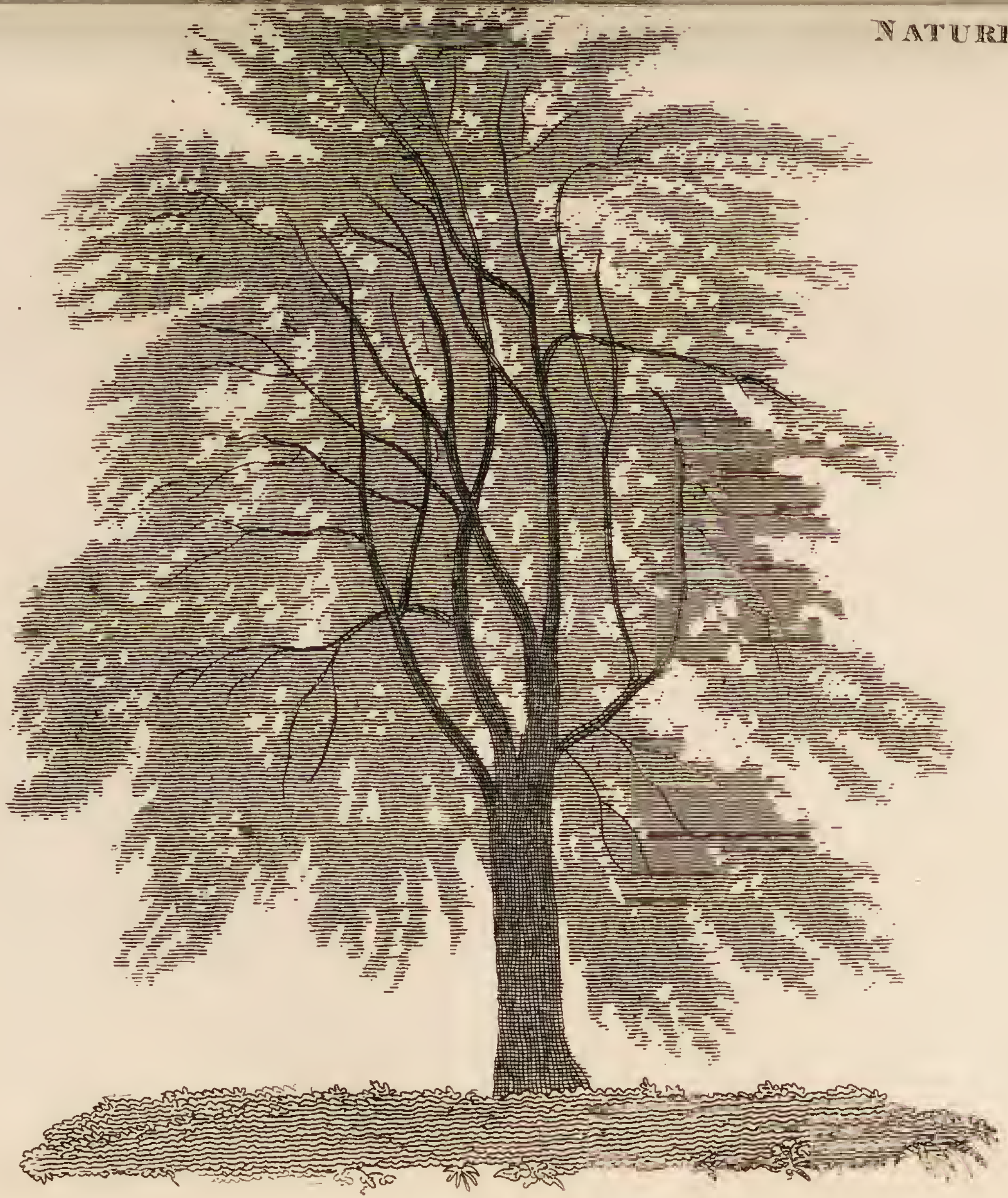
No tree in all the grove but has its charms,
Though each its hue peculiar; paler some,
And of a wannish grey—the *willow* such,
And *poplar*, that with silver lines his leaf;
And *ash*, far stretching his umbrageous arm.
Of deeper green the *elm.*
Some glossy-leav'd, and shining in the sun;
The *maple*, and the *beech* of oily nuts
Prolific; and the lime at dewy eve
Diffusing odours: nor unnoted pass
The *sycamore*, capricious in attire,
Now green, now tawny, and, ere autumn yet
Have chang'd the woods, in scarlet honours bright.
COWPER.

THE BEECH

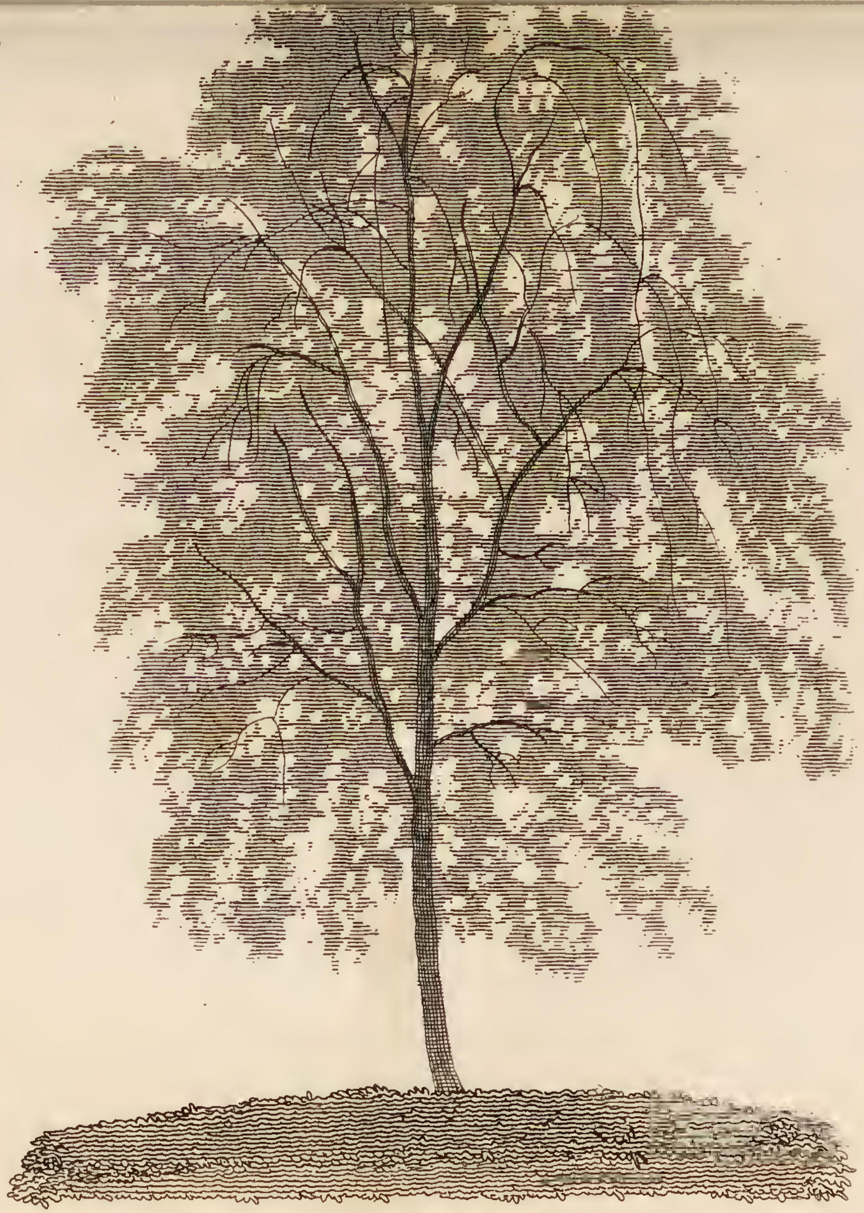
Is one of the most stately timber-trees, and thrives in dry chalky soils; when at a distance from other trees, it spreads to a wide extent; but in close plantations it rises to a great height, with elegance and airiness. Its smooth bark has from ancient times tempted the rural lover to carve the favourite name upon it; a custom recorded in various passages of the poets; and the opening of Virgil's first Eclogue represents the musing shepherd as reclining under the shade of a spreading beech:

Tityre tu patulæ recubans sub tegmine fagi.

This is one of the glandiferous or mast-bearing trees. Its nuts, eaten raw, occasion giddiness and head-ache;



BEECH



BIRCH

but, when dried and powdered, make wholesome diet. They are, however, chiefly the food of deer, swine, and squirrels, dormice, and other quadrupeds.

In the spring, the foliage of this noble tree, feathering almost to the ground, is exquisitely beautiful. Of a light delicate and lively green, it is scarcely equalled by any of the forest trees.* Whether standing singly, or in groups, their old fantastic roots are frequently covered with a profusion of wild flowers. In the deep shade of extensive beech-woods, however, nothing will grow; and their grey smooth trunks, extending as far as the eye can reach, give an impression of boundless solitude, and interminable shade.

THE CHESNUT

Is usually called the Spanish chesnut, as growing in greater perfection in Spain and other warm countries in Europe. Many think it a native of this island, as it arrives to the full bulk of a timber-tree in our woods and groves; and its appearance of an aged chesnut is striking and majestic. It throws out arms equal to those of the oak, often in an angular manner, thwarting each other, so as to produce an uncommon effect. The deep furrows of the rugged trunk sometimes form a kind of net-work by interlacing. The branches are richly clothed with long jagged leaves, of a pleasant green; and the head is massy and spreading. In autumn the leaves fade to a gold yellow, and afford a very conspicuous variety of tinge in the woods. It thrives in most soils and situations, but best in rich loamy land. Nothing will grow beneath its shade.

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* "There oft the muse, what most delights her, sees
Long-living galleries of aged trees;
Bold sons of earth, that lift their arms so high,
As if once more they would invade the sky.
In such green palaces the first kings reign'd,
Slept in their shades, and angels entertain'd:
With such old counsellors they did advise,
And, by frequenting sacred groves, grew wise.
Free from the impediments of lights and noise,
Man, thus retir'd, his noblest thoughts employs."

"We must not forget," says Evelyn, in his *Sylva*, "to praise the mast, which fattens our swine and families. It hath in some families even supported men with bread. Chios endured a memorable siege by the benefit of the mast; and, in some parts of France, they grind the bark in mills: it affords a sweet oil, which poor people eat willingly." The wood is brittle, and apt to decay, but being easily wrought it is much used by cabinet-makers.

This is the most valuable among the mast-bearing trees; its nuts, by their sweet and farinaceous quality, being good food for man, and other animals. The chesnuts cultivated for their fruit are usually grafted, and in the south of France they afford much sustenance for the poor, who make bread of their flour.

The chesnut-tree was formerly in great esteem. The wood is very durable, and some of the oldest houses are constructed with it. Fitz-Stephen, who lived in the reign of Henry II., speaks of an extensive forest of chesnuts, which sheltered the north side of London. An aged tree of this description is still growing at Tortworth, in Gloucestershire; proved to have stood there in the year 1150, when it was called "the great chesnut of Tortworth." It is conjectured to have flourished at least one thousand years, and to have been one hundred and fifty when John came to the throne. Mount Ætna is celebrated for some of the largest in the world. One of them is said by Houel to be 160 feet in circumference, and capable of sheltering one hundred persons. It is hollow, and contains a house used for drying chesnuts and almonds. Part of the road from Dorking to Betchworth Castle, in Surry, is overshaded by immense chesnut-trees, whose spreading branches and fine broad foliage render this line one of the most popular resorts of that enchanting county.

THE ASH,

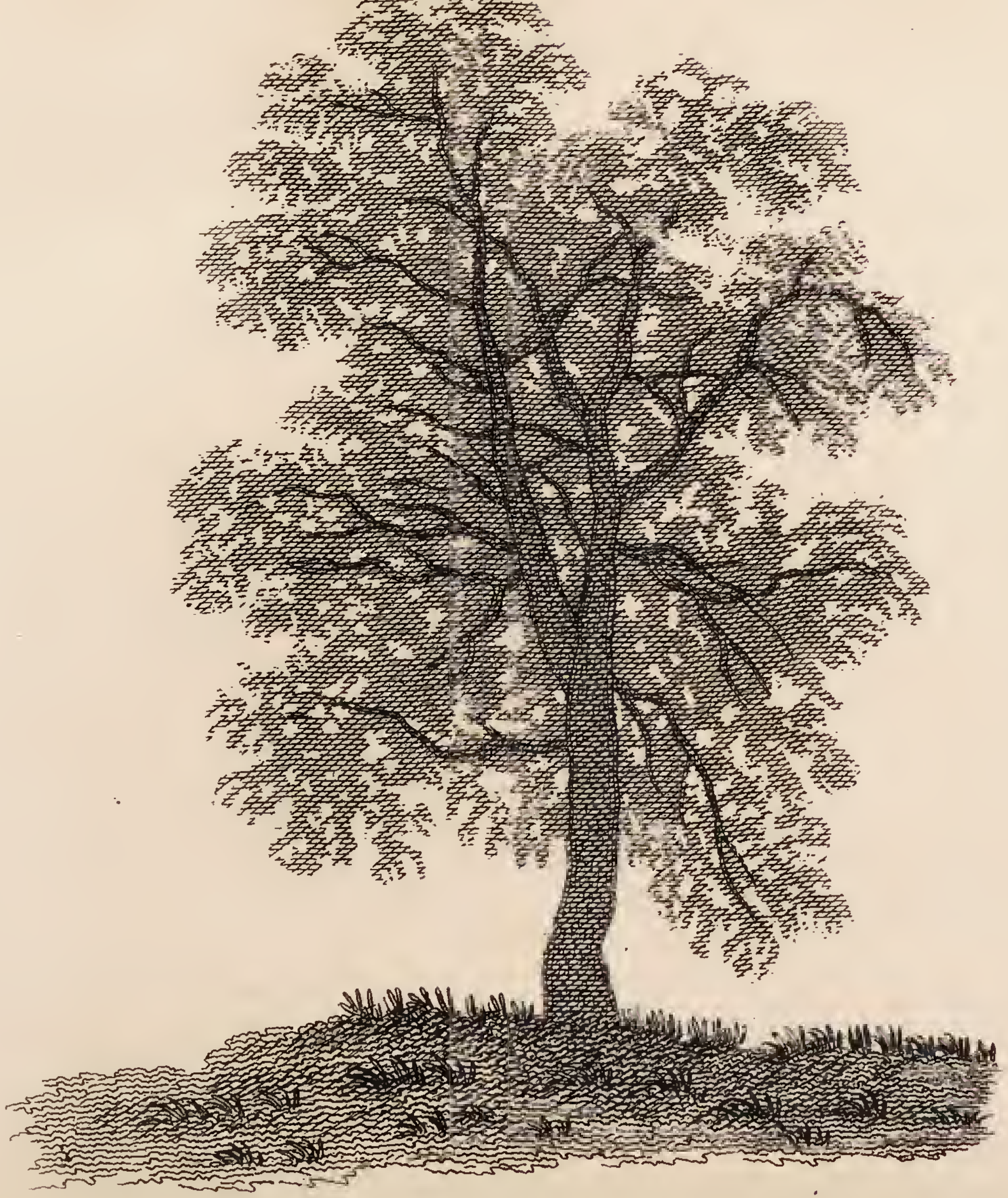
The Venus of the forest, is a tall tree, with a light thin quivering foliage and silver rind, giving it a graceful and elegant appearance, when contrasted with trees of greater mass and depth of shade. Its roots run along near the surface of the ground, and when planted on the sides of ditches, or in low boggy meadows, the roots ac as under drains, and render the ground about them firm and hard; but the wood is not so much valued. Its deleterious drippings injure herbage in upland pastures, and still more corn. When growing near water, its boughs hang like the weeping-willow. This tree is often met with in ruins and upon ancient walls, probably owing to the ease with which its winged seeds are borne by the wind; insinuating its roots into the crevices of these old buildings, it becomes an instrument of destroying what affords it support. In like manner it fastens upon loose slaty rocks, and decorates them with its verdure. It comes late into leaf, and loses its leaves early

LABURNUM.

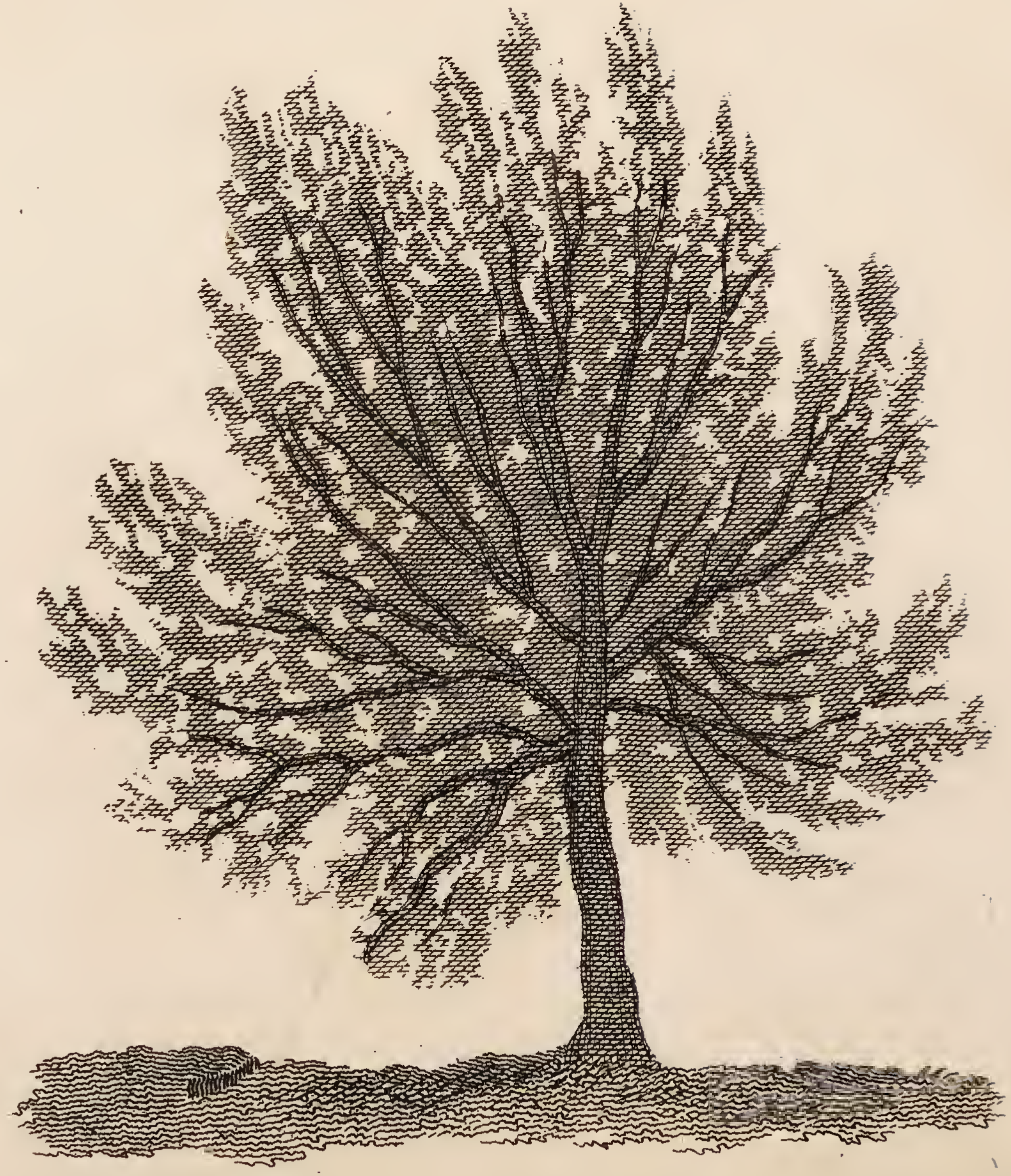
LAUREL.

London. Published by Sir R. Phillips & Co. Feb. 10. 1823.

Neele & Son 352 Strand



ASH.



ABELE OR POPLAR.

London, Published by Sir R.Phillips & C.o Feb.10.1823.

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in autumn. The bunches of long skinny seeds, called keys, on some trees almost destitute of leaves, have a singular unsightly appearance. Other trees seem never to bear any, yet abound in dark green foliage, and are pleasing objects. The bark is smooth and light-coloured. A well-grown ash is a handsome and elegant object, though all may not agree with the Roman poet in giving it the prize of beauty above all the natives of the forest. Few excel it in utility; its wood, next to that of the oak, is employed for numerous purposes. Thus Spenser, mentioning the particular uses of a number of trees, characterises the ash as " nothing ill."

It is peculiarly the husbandman's tree; being the principal material in ploughs, harrows, waggons, carts, and other implements for rustic use: hence ash-trees should be planted in every farm.

The loppings of the ash are used, in some parts of England, for the feeding of cattle, when, in autumn, the grass begins to fail. A curious petition is still extant, in which the inhabitants of Colton and Hawksheadfells remonstrated, in the reign of Queen Elizabeth, against the number of forges in the country, because they consumed all the loppings and croppings of the ash, the sole winter food for their cattle.

POPLARS.

The principal species of this tree are the white and black poplar, and the asp or aspen-tree. The white poplar, or abele, grows in woods and hedge-rows, especially in low moist situations, and is very conspicuous from the whiteness of its foliage:

> The poplar, that with silver lines his leaf. COWPER.

The name black is merely given to another species in distinction from the white. Its leaves are a pleasant green, nor has the tree any thing dark in its appearance. The leaves are smaller and more angular than those of the white. In a rich soil and moist situation, as the banks of rivers and the borders of meadows, the tree arrives at a great size, and is one of the tallest and most stately when full grown. As the roots do not run deep in the earth, the trees commonly lean, and are by high winds often blown down. It is common in Lancashire and Cheshire, where the long rows of poplars almost conceal from view the low-seated towns and villages.

The inner bark of the black poplar is used by the inhabitants of Kamtschatka as a material for bread; and paper has been made of the cottony down of the seeds.

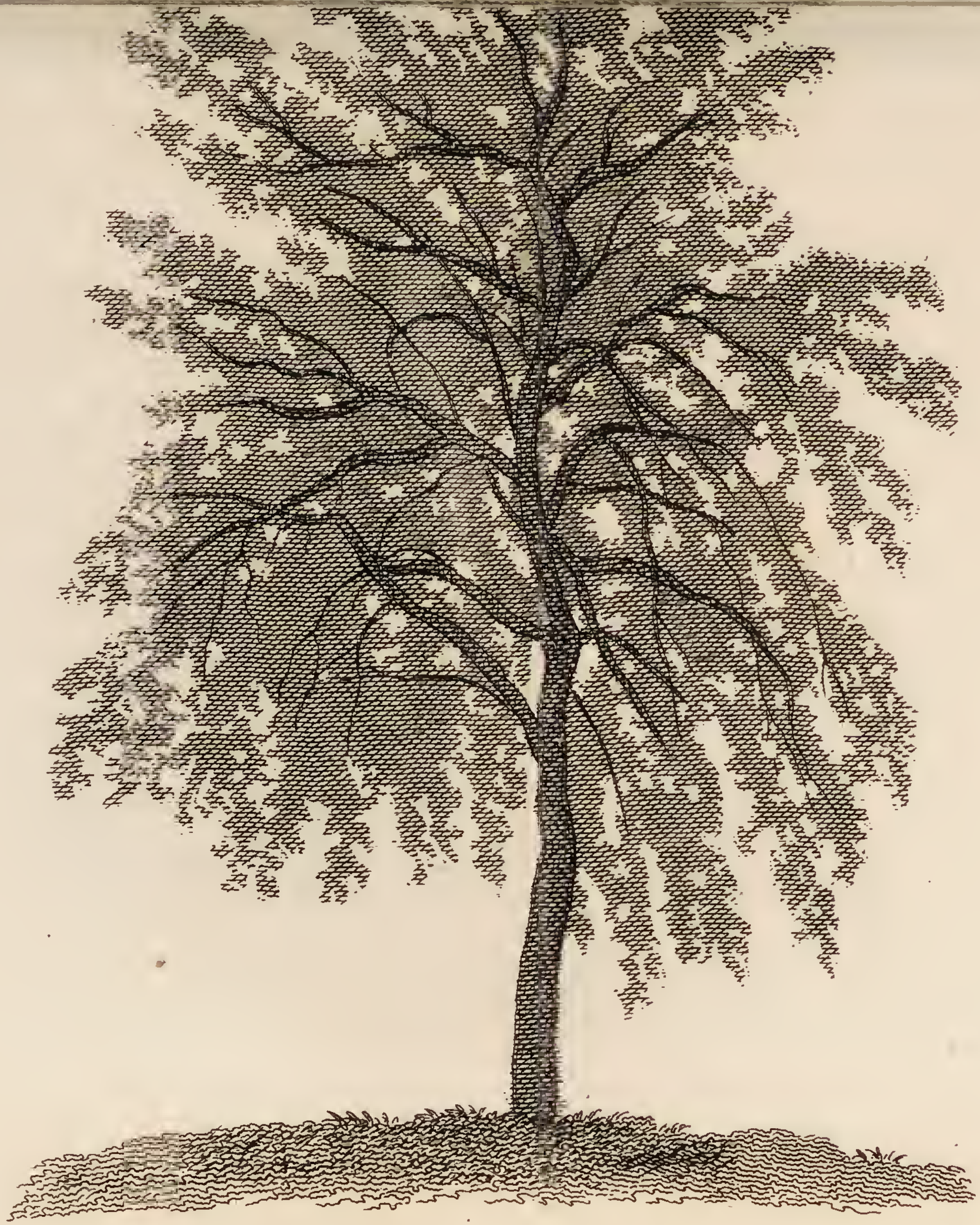
The ASP, OR ASPEN TREE, is remarkable for the constant tremulous motion of its small leaves with the lightest breeze. This tree is large, grows freely in all situations, but is injurious to grass; and its roots spread so near the ground, throwing out numerous shoots, that they suffer nothing else to grow near it. The wood is extremely light, white, and soft. Beavers are particularly fond of its bark and young shoots.

Several kinds of foreign poplar flourish well in our plantations. The Po, or Lombardy poplar, has lately become a great favourite, from its quick growth, and the ease with which it is reared.

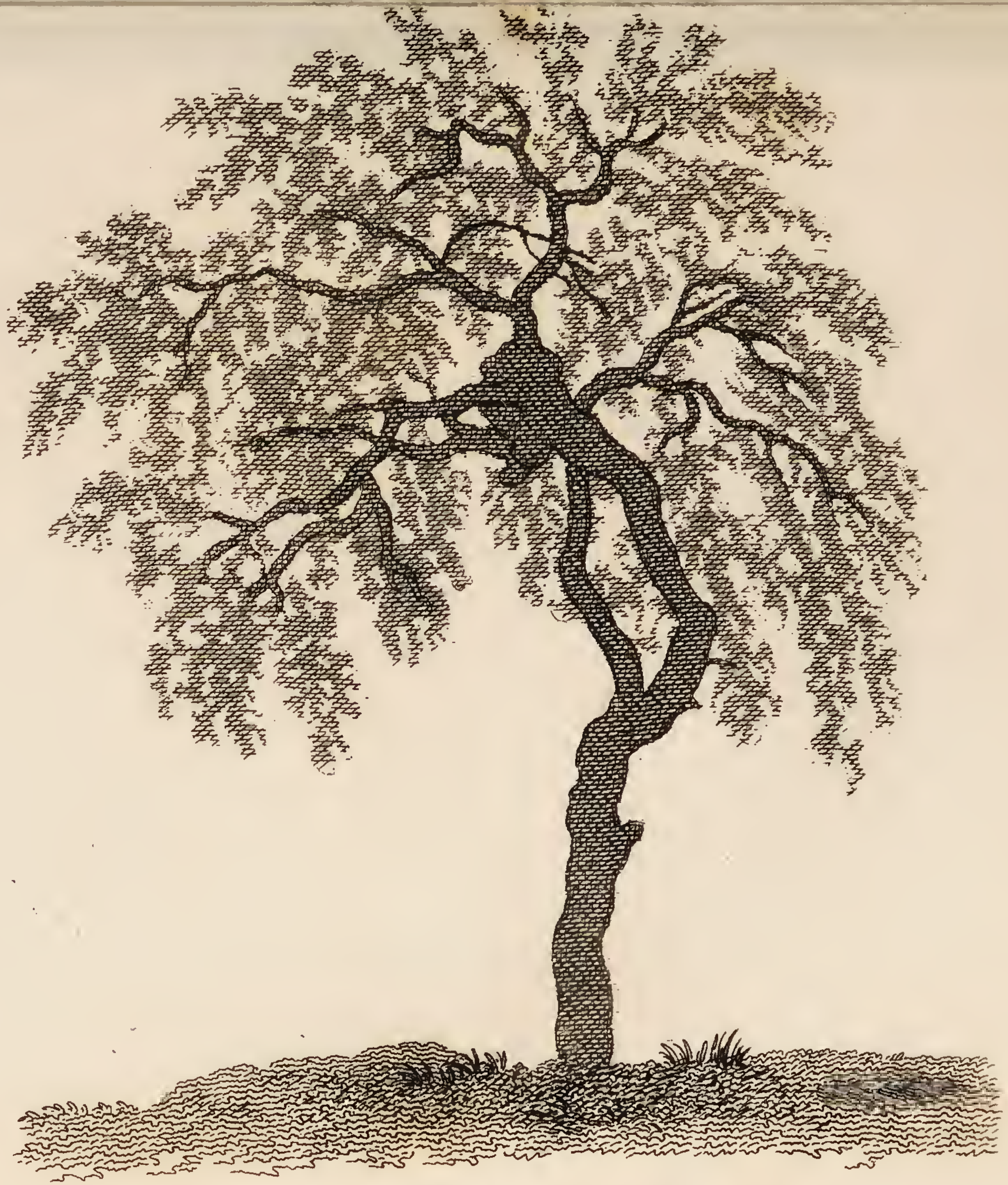
THE OCCIDENTAL, OR VIRGINIA PLANE

RISES with a straight smooth stem, to a great height, branching widely round; it has lobated leaves, seven or eight inches long, and from nine or ten to twelve or fourteen broad, divided into three large lobes, and very small flowers, collected into round heads, succeeded by round rough balls of seed. In Virginia, and other parts of North America, it attains an enormous size, and is remarkable for having its stem all of an equal girth for a considerable length: some trees, eight or nine yards in circumference, when felled, have been known to afford twenty loads of wood.

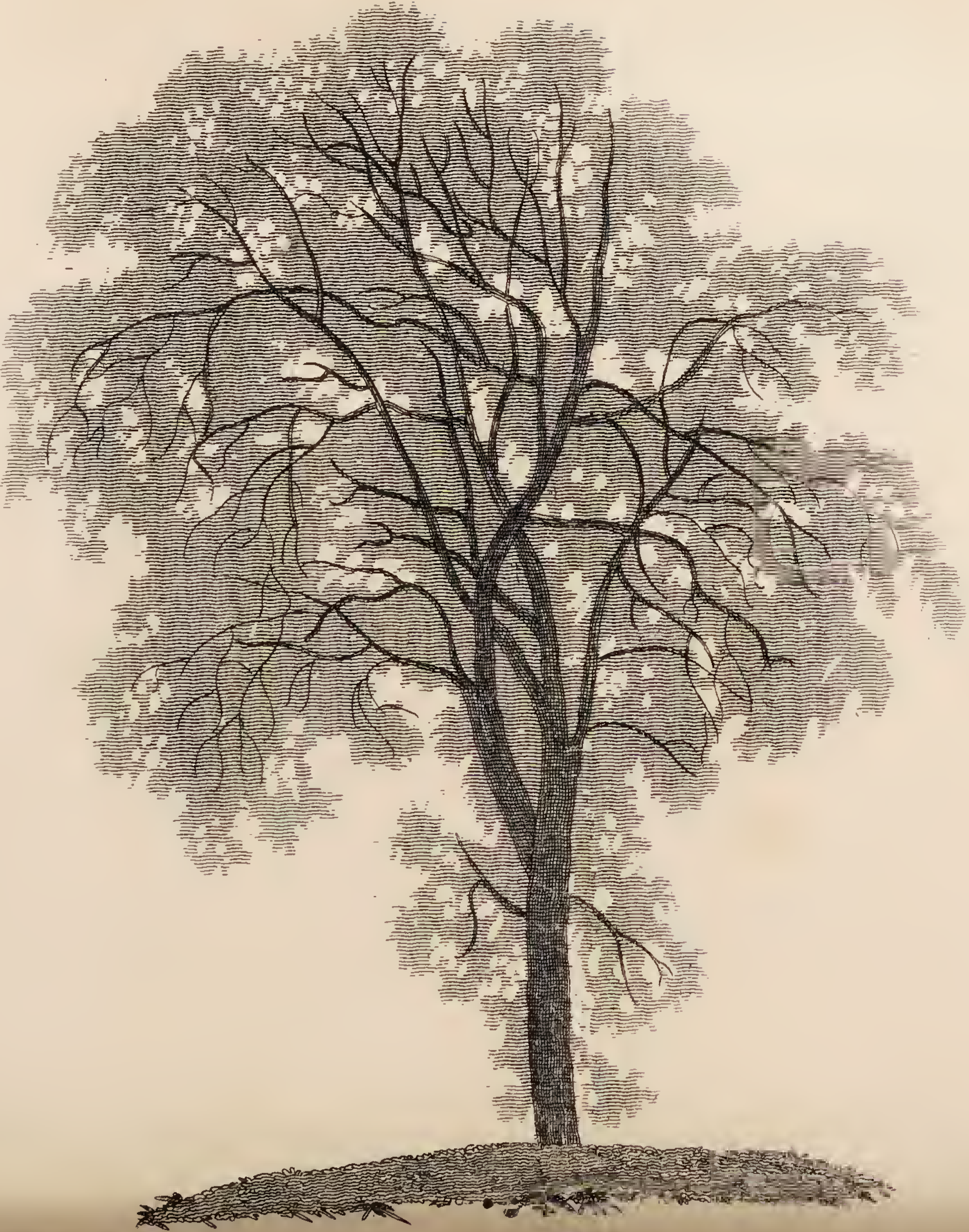
These elegant trees are of hardy temperature, so as to prosper here in any common soil and exposure in our open plantations, &c. and are some of the most desirable deciduous trees. They were in singular esteem among the ancients of the east, for their extraordinary beauty, and the delightful shade they afforded by their noble foliage. The leaves commonly expand in May, and fall off early in autumn; and the flowers appear in spring, a little before the leaves, being succeeded by seeds, which in fine seasons frequently ripen here in September. These fine trees are singularly fitted for ornamental plantations. Their straight growth, regular branching heads, and their lofty stature, together with the extraordinary breadth of their luxuriant leaves, render them extremely desirable furniture to adorn avenues, lawns, parks, and woods, disposed in ranges or single standards, in clumps, in groves, &c. They are most excellent for shade; for no tree is better calculated to defend from the heat in summer, by its noble spreading foliage, and to admit the sun's rays more freely in winter, on account of the distance of its branches, which is always in proportion to the size of the leaves.



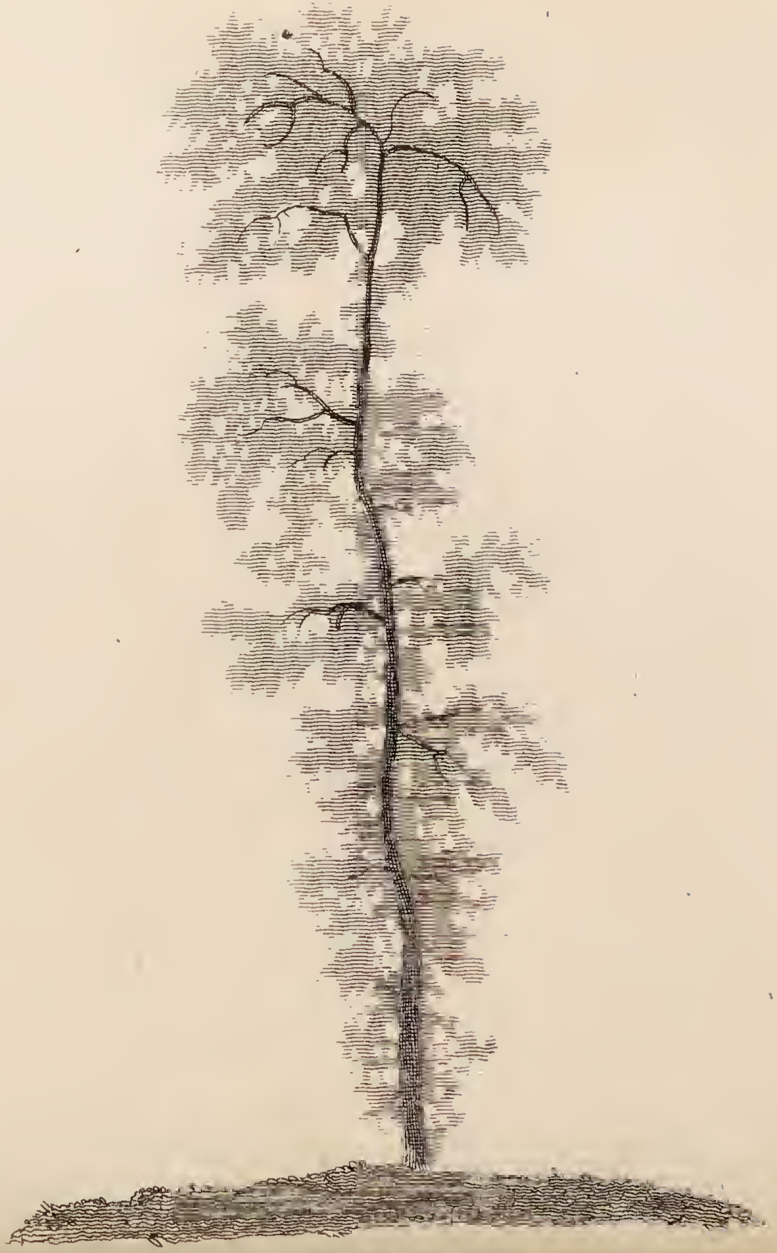
ASPIN.



POLLARD-ASPIN.



ELM



LOPPED ELM

London, Published by Sir R. Phillips & C.º Feb. 10, 1823.

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THE BIRCH

Is a tree of rather humble growth, but valuable for clothing soils deserted by most other trees, (as the bogs and morasses in some parts of this kingdom,) and common in some northern countries, as Sweden, Norway, and Lapland. The watery parts of forests, which scarcely produce any grass, are often covered with a thick growth of these trees; they likewise ascend the mountains, and mingle with fir and mountain-ash. The most elegant varieties grow in the romantic vale of Slugwy, near Bettros, in North Wales. The birch furnishes food to many kinds of moths, particularly the beautiful *agaricus muscarius.*

THE ELM.

> ———————There, fast-rooted in his bank
> Stand, never overlooked, our favourite elms
> That screen the herdsman's solitary hut. COWPER.

THE calyx of the elm is quinquefid. The fruit is a dry, compressed, membranaceous berry. The leaves are rough, oval, pointed, doubly serrated, unequal at the base. The bark of the trunk is cracked and wrinkled, and the fruit membranous. Hence it is often planted singly, or a few together, in village greens, affording both a majestic object and a pleasant summer shelter.

The ancients used elms properly trimmed to support their vines; and the poets frequently allude to the marriage of these dissimilar plants, and the aid derived to the weak and fruitful vine by twining round the strong stem of her husband elm. The elm thrives best in an open situation and a black clayey soil, and bears transplantation well; does not injure the grass beneath it; and its leaves are agreeable to cattle. The wood is hard, tough, and useful for many purposes; particularly for being kept constantly wet, as water-pipes, mill-wheels, and water-works, the water-line of ships, and the keels and planking beneath, first caused its frequency about London, trained without branches to a tall straight trunk, which may admit of boring in long pieces. It is also used for axle-trees, naves, gate-posts, and rails, floors, dressers, blocks, &c. and is well adapted for the carved and ornamental works in architecture.

There are several varieties of the elm, differing in their rough and smooth leaves, and manner of growth. A dwarf kind is employed for making tall hedges or screens in gardens, or nursery-grounds. They also form a fine walk or avenue:

> ——— The grove receives us next;
> Between the upright shafts of whose tall elms
> We may discern the thresher at his task. COWPER.

THE WEEPING-WILLOW

Is well known to the lovers of picturesque beauty, from that disposition to hang down in long slender branches, which makes it an admirable accompaniment to a still retired piece of water, with the melancholy character of which it is perfectly in unison. In misty weather, drops of water are seen distilling from the extremities of its branches; which circumstance has given it a name, and wonderfully aids its effect.

The weeping-willow grows to a large size, and attains a considerable age. One was lately cut down, planted in his own garden, by the hand of Pope, and said to have been one of the first of its species introduced into this kingdom.

THE YEW

Is found in rocky and mountainous situations, where its trunk sometimes attains a moderate height and great thickness, and the gloomy darkness of its foliage, calculated to awaken the most melancholy feelings, cause it to be named " the funeral yew."

It is, however, more celebrated in British history for the ancient use of its wood for the most formidable weapon of our ancestors, the long-bow; for which its toughness and elasticity rendered it peculiarly suitable. Thus Spenser characterises it as

> The *eugh* obedient to the bender's will.

Much force was, however, required in overcoming its resistance, and the archer must have had a strong arm

> ———— who drew,
> And almost joined, the horns of the tough yew.

It was commonly planted near houses, both for its utility and fitness for cutting into those artificial shapes formerly thought highly curious and ornamental; and thus pyramids, obelisks, birds, and beasts of yew decorated the court-yards of our country-houses, and supplied matter of admiration for our ancestors.

The yew now grows commonly in church-yards, and, according to ancient records, much attention seems to have been devoted to planting it there in former times.

Various are the conjectures for the universal custom of planting the yew in burying-places.* One reason is

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* In the will of King Henry VI. there is the following item:— " The space between the wall of the church and the wall of the cloyster shall conteyne 38 feet, which is left for to sett in certain flowers and trees behovable and convenient for the service of the said church."

POLLARD WEEPING WILLOW.

YEW.

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obvious: its sombre and doleful aspect render it an emblem of mourning. This idea originated with the Egyptians; from them it was adopted by the Greeks; then by the Romans; from whom the countries they conquered naturally borrowed it. Hence its introduction into Great Britain. The yew was formerly as common in the church-yards of Italy, as it is now in those of Wales. In many villages the yew-tree and the church are coeval. It was formerly consecrated to religious purposes; on Palm Sunday the yew was often substituted for the palm; the boughs were blessed with many ceremonies; some were burnt to ashes, and, on the following Ash-Wednesday, used by the priest for signing the foreheads of the people with this memento, "Remember, man, dust thou art, and to dust thou must return."

The CYPRESS may be said to resemble the yew in its sombre appearance, and was much used in the funeral ceremonies of the ancients. The sepulchres and monuments of the Corinthians were principally among groves of cypresses.

THE LIME

Is a beautiful tree, and cultivated rather on that account than for utility. It grows straight and taper, with a smooth, erect trunk, and a fine spreading conical head. Its leaf is large, and its bark smooth. In a good soil it thrives to a great height and stately size, and its chief glory arises from society.

It is much employed for avenues and borders. Some straight walks of ancient limes, by modern taste hitherto spared, are beautiful specimens of the pointed arch made by the intersection of branches, supposed to be imitated in the Gothic architecture of cathedrals.

In Betchworth Park, Surry, is a fine avenue, 350 yards in length, composed of limes of gigantic size and height. This line resembles the nave of a cathedral: the trees form on the outside a vast screen or wall of verdure; within, the branches, meeting at a great height in the air from the opposite rows, form gothic arches, and exclude every ray of the meridian sun.

THE WALNUT,

THOUGH not a native of our woods, is planted so often, and so well perfects its fruit and timber, that it seems fairly naturalized. It is best in a rich loamy soil, but will grow well on stony or chalky ground; hence it thrives on the downs of Surry. The tree arrives at a large size and a bold figure, either set in rows or single; but it gets its leaves late, and sheds them early.

As a timber-tree, the walnut is in less request than formerly; its place being supplied by foreign woods. It is rather brittle, yet is used by cabinet-makers for bedsteads, chairs, tables, and bureaus, being one of the most durable English woods; also for wainscots, and for gun-stocks. The wood near the root is often beautifully veined, and fit for inlaying and ornamental works; and the more knotty, the greater its value. The black Virginia walnut, however, excels ours for these uses. For the sake of the fruit the walnut is chiefly cultivated; being one of the most grateful nuts, and a welcome addition to desserts, while fresh and moist; being similar in quality to almonds.

THE HOLLY

Grows native in woods to the height of 20 or 30 feet; but we more usually see it in gardens as a shrub. It is an evergreen, and its shining leaves and red berries principally decorate the winter landscape. Armed by nature with thorns, projecting from the indentations of the leaves, it is selected by man to protect his cultivated plants, and formed into hedges impenetrable to all the foes of the garden; yet not more useful than the hawthorn. Were it not for its slow growth, no native of this climate would be preferred to the holly for this purpose. Mr. Evelyn speaks with rapture upon this subject: "Is there under heaven a more glorious and refreshing object of the kind, than an impregnable hedge of about 400 feet in length, nine feet high, and five in diameter, which I can show in my now ruined gardens at Say's Court, at any time of the year, glittering with its armed and varnished leaves; the taller standards at orderly distances, blushing with their natural coral? It mocks the rudest assaults of the weather, beasts, or hedge-breakers, *Et illum nemo impune lacesset.*"

By the skilful budding or grafting of the gardener, from the common holly are derived numerous varieties, distinguished by their leaves, and disposition of their prickles. Some are very curious and beautiful, and are rich ornaments to a shrubbery.

THE ELDER.

The *nigra*, or common black elder-tree, rises with a

WALNUT

WILLOW

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ELDER.

LARCH FIR.

tree-stem, 20 or 30 feet high, branching numerously into a large spreading head, pinnated leaves, of two or three pair of oval lobes, and an odd one; and large five-parted umbels of white flowers towards the ends of the branches, succeeded by bunches of black, and other different-coloured berries, in the varieties.

The *(racemosa,)* recemose, or red-berried elder, rises with a tree-like stem, branching 10 or 12 feet high, having reddish-brown branches and buds; pinnated leaves of six or seven oval deeply-sawed lobes; and compound, oval, racemous clusters of whitish-green flowers, succeeded by oval clusters of red berries.

This is a resident of the mountainous parts of the south of Europe, and is retained in our gardens as a flowering shrub, having a peculiar singularity in its oval-clustered flowers and berries.

The *Canadensis*, or Canada shrubby elder, rises with a shrubby stem, branching 8 or 10 feet high, having reddish shoots; somewhat bi-pinnated leaves, often ternate below, the other composed of five, seven, or nine oval lobes; and, towards the ends of the branches, cymose quinquepartite umbels of flowers, succeeded by blackish-red berries.

All the sorts are deciduous, very hardy, and grow freely; are generally free shooters, particularly the common elder and varieties, which make remarkably strong, jointed shoots, several feet long, in one season; and they flower mostly in summer, except the racemose elder, which generally begins flowering in April; and the branches being large, spreading, and very abundant, are exceedingly conspicuous; but they emit a most disagreeable odour. The flowers are succeeded, in most of the sorts, by large bunches of ripe berries in autumn, which, although very unpalatable to eat, are in high estimation for making that well-known cordial liquor called elder-wine, particularly the common black-berried elder.

FIRS.

The pine tribe form a large and important family in trees, distinguished by their stiff, narrow, pointed leaves, of a dark hue, generally evergreen, and scaly cones. Some of them affect mountainous situations; others bogs and swamps; and they often compose woods of vast extent, clothing barren and desolate regions unfit for human culture.

The Scotch Fir is so called, because it grows naturally in some part of the Highlands of Scotland, perpetuating itself by the seedlings from the fallen cones. It is not, however, peculiar to that country, but grows abundantly in the mountains of Norway, Sweden, and Russia, covering the sides of the highest hills, often beyond the reach of man. It thrives in any temperate climate, and most in poor sandy soils. In a thick wood or grove it grows up with a straight naked trunk; but in an open sunny exposure it spreads out with wide branches. As only the terminating buds send forth shoots, it will not bear the least clipping. It frequently produces an imposing effect in woodland scenery, especially when contrasted with others of a different character.

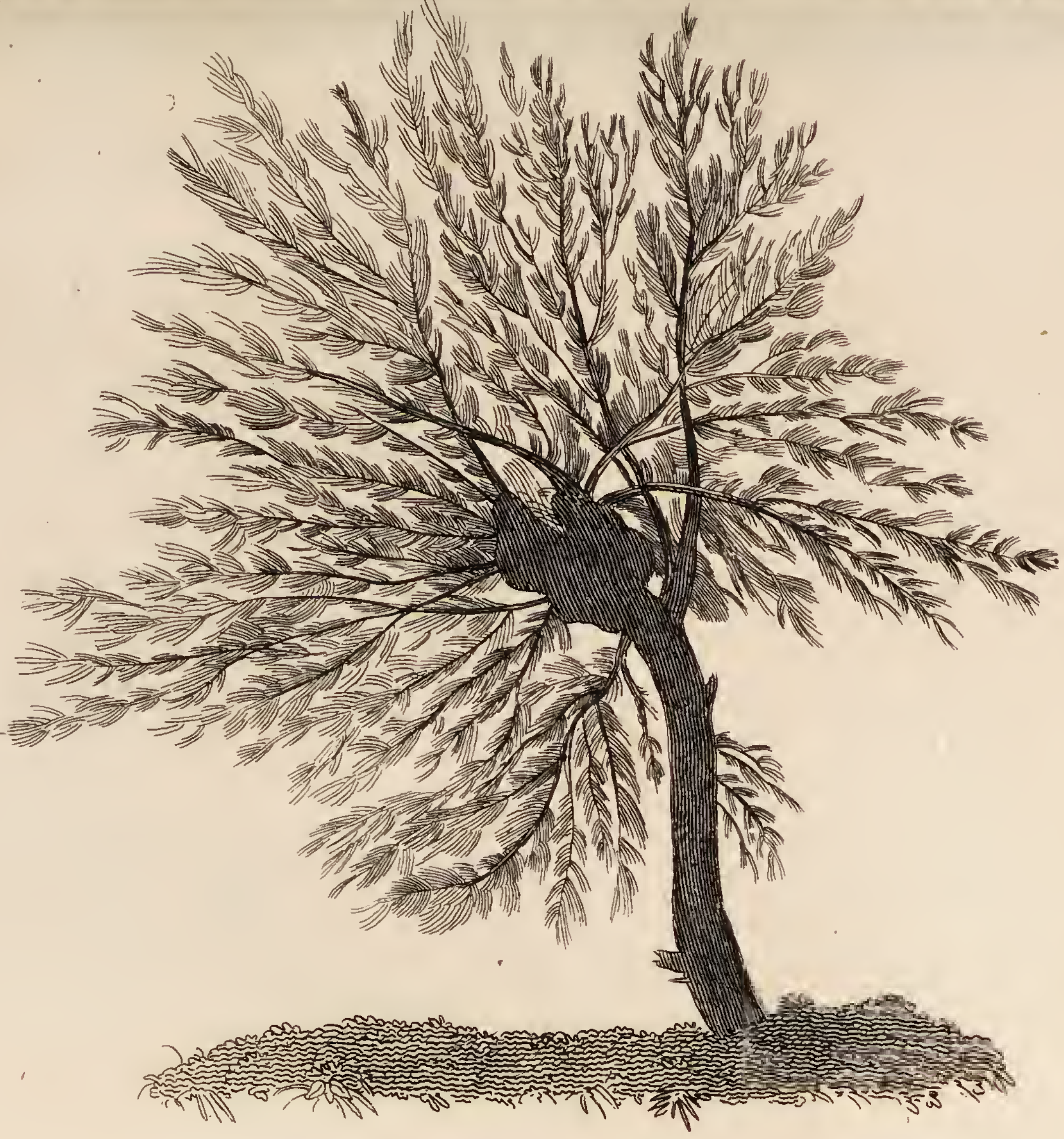
In the distance, a fine group of fir-trees appear like dark green pyramids, devoid of motion, bringing to recollection the purpose to which their inflammable qualities were applied by Ceres, when seeking the lost object of her affections.

> "At Ætna's flaming mouth two pitchy pines,
> To light her in her search, at length she tines;
> Restless with these, through frosty night she goes,
> Nor fears the cutting wind, nor heeds the snows."

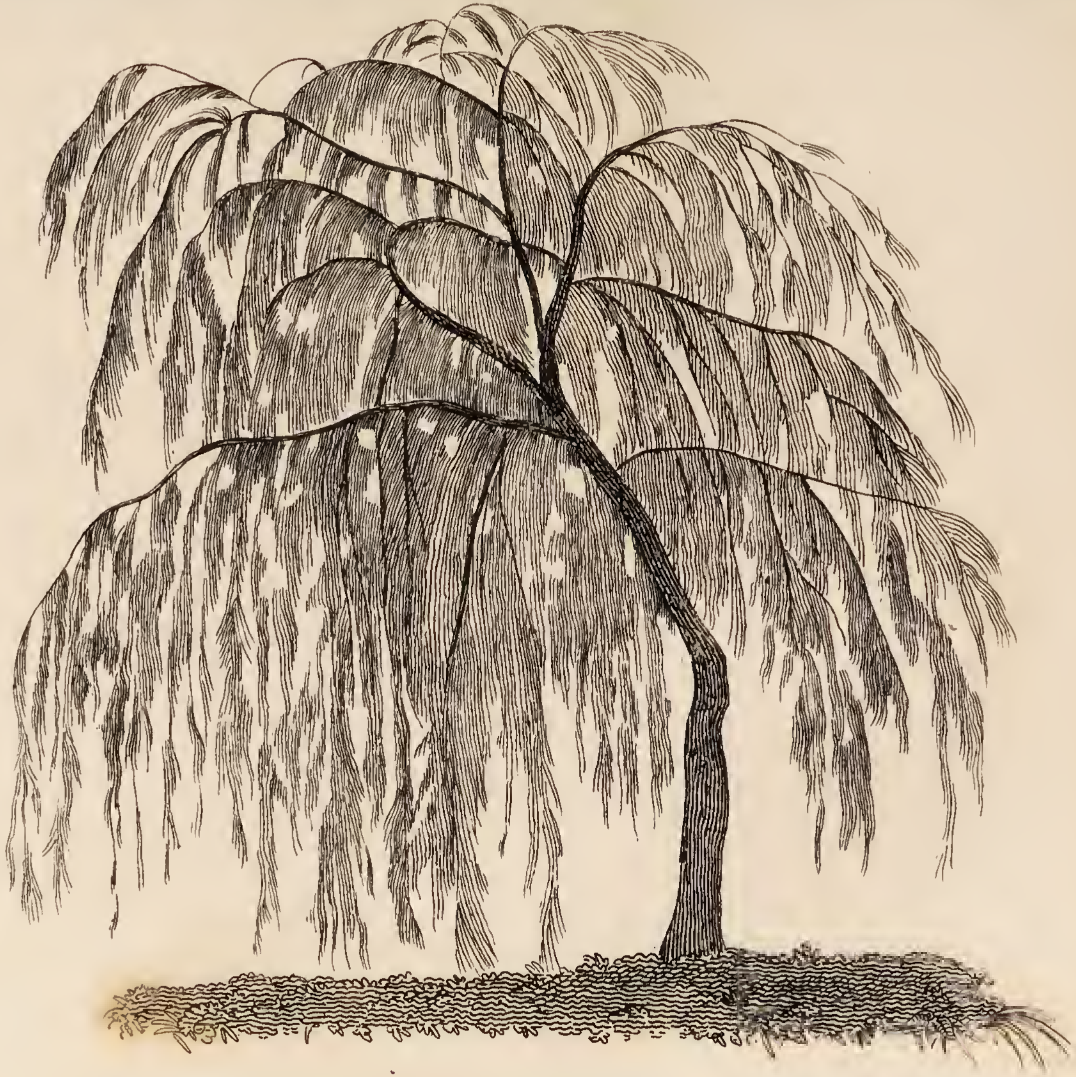
Those which are seen from the Castle Rock are beautifully relieved by several graceful varieties of the *betula alba*, or birch-tree, whose foliage continually plays about with every breath of wind. The bark is similar to leather in pliancy; and so incorruptible, that (according to Pliny and Plutarch,) the books of philosophy and religion, written on it, and deposited in the tomb of Numa Pompilius, were discovered at Rome four hundred years afterwards, in such high preservation that Petilius, the pretor, read them by command of the senate. The bark consists of ten or twelve laminæ, white and thin, like paper, for which it was used by the ancients.

The Spruce Fir grows plentifully in Norway, which is valuable for its timber, the white deal. From the green tops of this species is made the spruce, esteemed in America as a remedy for scorbutic disorders.

The Silver Fir grows to a straight, tall tree. It is named from the hue of its leaves, their upper surface being of a full green; but the under has two white lines parallel to the mid-rib, giving it a silvery appearance from below. The leaves much resemble those of the



POLLARD WILLOW.



WEEPING WILLOW.

PALM

ITALIAN PINE

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yew, whence its name, and of the yellow-leaved fir and *picea*, being that whence tar or pitch is extracted. It is a native of Norway, and yields the yellow deal.

The **Weymouth Pine**.—The white pine of North America often grows to 100 feet. It is, therefore, preferred for masts of ships; and our largest men-of-war are furnished from trunks of this pine collected in the yards of Nova Scotia. They were first cultivated in England by Lord Weymouth; hence they generally here bear his name, and are common in plantations.

The **Larch**, a native of the Alps and Apennines, is now common in our nurseries and plantations, and has lately sprung up self-sown in the Highlands of Scotland. In beautiful appearance, and durability, it much surpasses the Scotch fir, and thrives in soils and situations equally unpromising. Its leaves fall in winter, but not till they are almost immediately succeeded by fresh ones. The wood is considered, in the countries where it is employed for timber, as almost imperishable. The young shoots are peculiarly palatable to the stag and squirrel; which latter animal is a very mischievous inhabitant of larch plantations, often gnawing off the leading shoot of the young trees.

From the larch-tree is extracted Venice turpentine. This natural balsam flows at first without incision; when it has done dropping, the poor people who wait in the fir-woods, at two or three feet from the ground, make incisions into the trunks of the trees, into which they fix narrow troughs, 20 inches long, the end hollowed like a ladle; in the middle is a small hole bored. As the gummy substance runs from the tree, it passes along the sloping trough to the ladle, and from thence through the hole into the receiver below it. It is procured in abundance in the neighbourhood of Lyons, and in the valley of St. Martin, near St. Lucern, in Switzerland.

The process of making pitch, tar, resin, and turpentine is thus:—In the spring, when the sap runs most free, they pare off the bark of the pine-tree, to make the sap run into a hole cut at the bottom. As it runs down, it leaves a white matter, like cream, but thicker. This is very different from all the kinds of resin and turpentine in use, and is generally sold to be used in making flambeaux, instead of white wax. The matter received in the hole at the bottom is taken up with ladles, and put in a large basket; most of this immediately runs through, and is the common turpentine, received into stone or earthen pots, and ready for sale. The thicker matter remaining in the basket, is put into a common alembic, adding plenty of water. They distil this as long as any oil swims on the water. This oil they separate from the surface in large quantities, and is the common oil or spirit of turpentine.

The *tillandria*, or wild pine, of the West-Indies, has every leaf terminated near the stalk with a hollow bucket, which contains from half-a-pint to a quart of water, thus affording a grateful refreshment to thirsty travellers. In the burning sands of Africa, a large tree, called by the negroes *boa*, has been frequently observed, the prodigious trunk of which is naturally hollowed like a cistern. During the rainy months it is filled with water, which continues fresh and cool, during the intense heat of the summer months, by means of the tufted foliage which crowns its summit.

The swamps of the Bay of Campeachy are so parched during summer, that the huntsmen, who lose themselves in the extensive forests, would be in danger of perishing with thirst, were they not provided with living fountains in the trunks of a kind of pine, indigenous to the soil, which are covered with a species of fungus, called, from their peculiar form, pine-apples. They resemble a packet of leaves piled one upon the other, and are so full of sap, that, on piercing them with a knife at the base, nearly a pint of clear juice immediately distils.

THE CEDAR,

Famous for its duration, is popularly called the cedar of Lebanon, by the ancients *cedrus magna*, or the great cedar; and sometimes the Phœnician or Syrian cedar, from the country where it grows in greatest perfection. It is a large coniferous evergreen, bearing roundish cones of smooth scales, erect, the leaves being small, narrow, and thick set. Cedar wood is reputed almost immortal and incorruptible; which prerogative it owes to its bitter taste, which the worms cannot endure. For this reason the ancients used cedar tablets to write upon, especially for things of importance; hence Persius says, *Et cedra digna locutus.* A juice drawn

CEDAR

CYPRESS

SCOTCH FIR.

SPRUCE OR NORWAY FIR.

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from cedar was used to smear their books and writings, to preserve them from rotting; by which, Numa's books, written on papyrus, were preserved entire to the year 535.

Solomon's temple and palace were of this wood. That prince gave king Hiram several cities for the cedars furnished him. Cortes erected a palace at Mexico, with 7,000 beams of cedar, of 120 feet long, and 12 in circumference. Mention is made of a cedar felled in Cyprus, 130 feet long, and 18 in diameter, used for the main-mast of the galley of king Demetrius. Le Bruyn saw two on Mount Lebanon, one 57 palms, and the other 47, in circumference. In the temple of Apollo at Utica, were cedars near 2,000 years old, yet little to that beam in an oratory of Diana at Seguntum, in Spain, said to have been brought thither 200 years before the destruction of Troy. Cedar is of so dry a nature, as not to endure being fastened with iron nails, from which it usually shrinks; hence is commonly fastened with pins of the same wood. The statue of the great goddess at Ephesus was made of this material; and if this tree abounded with us, it might have a principal share in our most superb edifices. The effluvia constantly emitted from its wood purify the air, and make rooms wholesome. Chapels, and places set apart for religious duties, wainscoted with this wood, would inspire the worshippers with a more solemn awe. It is obnoxious to worms; and emits an oil which will preserve cloth or books from worms or corruption. The saw-dust will preserve human bodies from putrefaction; and is therefore plentifully used in the rites of embalming, where practised.

This tree is not found as a native in any other part of the world than mount Libanus. What we find mentioned in Scripture of the lofty cedars, is inapplicable to the common growth of this tree; since, from the experience we have of those now growing in England, as also from the testimony of travellers who have visited those few remaining trees on mount Lebanus, they grow very slowly, but extend their branches very far. The finest cedars in England are said to be those at Mickleham, near Dorking, in Surry.

In Ashantee grows a cedar, whose leaves exude a considerable quantity of liquid salt, which crystallizes during the day. Likewise in Chili, a species of wild is every morning covered with saline globules, resembling dew, which the natives use as salt.

The accompanying Engravings are copied from Coozen's beautiful sections of British Trees.

The chief part of our *exotic* flowers and fruits have been at different times transplanted into this country by many of our travelling nobility and gentry. Some names have been casually preserved. The learned Linacre first brought, on his return from Italy, the damask-rose; and Thomas Lord Cromwell, in the reign of Henry VIII. enriched our fruit-gardens with three different plums. In the reign of Elizabeth, Edward Grindal, afterwards archbishop of Canterbury, returning from exile, transported here the medicinal plant of the Tamerisk. The first oranges appear to have been brought into England by one of the Carew family; and for a century after they still flourished at the family seat at Beddington, in Surrey. The Cherry orchards of Kent were first planted about Sittingbourne, by a gardener of Henry VIII: and the Currant-bush was transplanted when our commerce with the island of Zante was first visited in the same reign. To Sir Walter Raleigh, we have not been indebted solely for the luxury of the tobacco-plant, but for that infinitely useful root, which forms a part of our daily meal, and often the entire meal of the poor man—the potatoe, which deserves to have been called a *Raleigh*. Sir Anthony Ashley first planted cabbages in this country, and a cabbage at his feet appears on his monument. Sir Richard Weston first brought clover-grass into England from Flanders, in 1645; and the figs planted by Cardinal Pole at Lambeth, so far back as the reign of Henry VIII., are said by Gough to be still remaining there: nor is this surprising, for Speman, who set up the first paper-mill in England, at Dartford, in 1590, is said to have brought over in his portmanteau the two first lime-trees, which he planted here, and which are still growing. The first mulberry-trees in this country are now standing at Sion-house, and James the First took pains to increase them by royal proclamation.

The very names of many of our vegetable kingdom indicate their original locality: from the majestic cedar of Lebanon, to the small cos-lettuce, which came from the isle of Cos; the cherries from Cerasuntis, a city of Pontus; the peach, or *persicum*, or *mala persica*, persican apples, from Persia; the pistachio, or *psittacia*, is the Syrian word for that nut. The chesnut, or *chataigne*, in French, and *castagna*, in Italian, from Castagna, a town of Magnesia. Our plums coming chiefly from Syria and Damascus, the damson, or damascene plum, affording us a recollection of the country of its origin.

Peacham, in 1612, mentions that cherries were not long known, and gives the origin to the name of Filbert.

> "The Persian peach and fruitful quince;
> And there the forward almond grew,
> With cherries known no long time since;
> The winter warden, orchard's pride;
> The *philibert* that loves the vale,
> And red queen-apple, so envide
> Of school-boies, passing by the pale."

LECTURE LXXVI.

TROPICAL TREES AND PLANTS.

> Bear me, Pomona! to thy citron groves;
> To where the lemon and the piercing lime,
> With the deep orange, glowing through the green,
> Their lighter glories blend. Lay me reclined
> Beneath the spreading tamarind that shakes,
> Fann'd by the breeze, its never-cooling fruit.
> Deep in the night the massy locust sheds,
> Quench my hot limbs; or lead me through the maze,
> Embowering endless, of the Indian fig;
> Or, thrown at gayer ease, on some fair brow,
> Let me behold, by breezy murmurs cool'd,
> Broad o'er my head the verdant cedar wave,
> And high palmettos lift their graceful shade.
> Or, stretch'd amidst these orchards of the sun,
> Give me to drain the cocoa's milky bowl,
> And from the palm to draw its freshening wine,
> More bounteous far than all the frantic juice
> Which Bacchus pours. Nor, on its slender twigs
> Low bending, be the full pomegranate form'd;
> Nor creeping through the woods, the gelid race
> Of berries. THOMSON.

In the preceding lecture we have treated of the most useful BRITISH FOREST TREES and SHRUBS, besides several foreign varieties which have been introduced into this country. We shall next proceed to particularise the principal species of the most important TROPICAL TREES and PLANTS, of the luxuriant and important general characters of which we have spoken in the last lecture but one.

THE PALM TRIBE

Is a stately and colossal order, so named from *palma*, the ancient appellation of the Date, the most valuable among them, whose foliage was consecrated, by the Greeks and Romans, as an emblem of victory, and whose fruit, from the remotest antiquity to the present day, has been a principal article of food in the east.

The following characteristic sketches of this remarkable family of the vegetable kingdom, are extracted from the magnificent botanical work of Messrs. Humboldt and Bonpland.

The family of the palm thrives best between the tropics. Yet some, which the travellers believe to have been wholly unknown previously to their visit to the Andes, approach the limits of everlasting snow. If the family of the palms is distinguished by beauty of form, and its large size, from almost all the other families of vegetables, so likewise does it surpass them in the various uses to which they are applied. They furnish articles of the most dissimilar nature; wine, oil, wax, flour, sugar, and salt.

In the tracts to the north of the line, between the mountains of Caraccas and the river of Amazons, traversed by Humboldt and Bonpland, they found the palms in general in blossom in January and February, but some of them flower at other seasons of the year. Their fecundity is astonishing; the powerful action of the sap is developed, not only in thick umbrageous foliage, but also in an innumerable multitude of flowers and fruit. Not only the fields planted with palm-trees, but even the soil that has never been cultivated by man, is frequently covered to the depth of three inches with the fruit of the Cocos butyracea, the Mauritia, &c. Every flower-capsule of the date-tree contains, according to Kæmpfer, above 12,000 male flowers. Humboldt and Bonpland have found a much greater number upon another species. In one single catkin-shaped bunch of flowers, of which each capsule contains from 110 to 120, they counted 1800 male flowers; so that the total number in each capsule may be computed at 207,000 flowers. According to a similar calculation every branch of a species which furnishes an excellent aliment on the banks of the Oroonoko, produces 8000 fruits, many of which indeed drop off before maturity. In the palm-grounds planted with the pihiguao, each tree yields annually, upon an average, 400 fruits of the shape of apples; and the Franciscans on the Oroonoko and Guainia know from experience, that, whenever there is an uncommonly abundant crop of palm-fruit, the Indians grow remarkably fat. And M. Humboldt observes that those species, the pith of which furnishes a kind of sago-flour, that forms an excellent article of food for the inhabitants of the New World, deserve to be particularly recommended to the notice of future travellers in America.

When the seed of a palm-tree is committed to the earth, (says M. Desfontaines) the leaves unfold in succession, and increase in number, during four or five years. The crown of the root dilates in the same proportion. The bulb, formed by the re-union of the footstalks of the leaves, swells insensibly, its solidity gradually augments, and at length the stem rises above the surface of the ground, of the full diameter that it ever will acquire. The leaves, produced every spring, originate always from the summit. The older ones, standing below the others, gradually dry up, and, on separating from the stem, leave behind them circular impressions, which furrow its surface, and mark the years of its age, as long as it continues to grow. The stem is exactly cylindrical from top to bottom; and, if its measure be taken at different periods, no increase of diameter will ever be discovered.

The dates hung from these trees, in Egypt, in such large and tempting clusters, although not quite ripe, that (says Dr. Clarke) we climbed to the tops of some of them, and carried away with us large branches, with their fruit. In this manner dates are sometimes sent, with the branches, as presents to Constantinople. A ripe Egyptian date, although a delicious fruit, is never refreshing to the palate. It suits the Turks, who are fond of sweet-meats of all kinds: and its flavour is not unlike that of the conserved green citron, which is brought from Madeira. The trees are very lofty, and, from the singular formation of their bark, we found it as easy to ascend to the tops of these trees as to climb the steps of a ladder. Wherever the date-tree is found in these dreary deserts, it not only presents a supply of salutary food for men and camels, but Nature has so wonderfully contrived the plant, that its first offering is accessible to man alone; and the mere circumstance of its presence, in all seasons of the year, is a never-failing indication of fresh-water near its roots. Botanists describe the trunk of the date-tree as full of rugged knots; but the fact is, that it is full of cavities, the vestiges of its decayed leaves, which have within them an horizontal surface, flat and even, exactly adapted to the reception of the human feet and hands; and it is impossible to view them without believing that HE, who in the beginning fashioned " every tree, in the which is the fruit of a tree yielding seed," as "meat for man," has here manifested one among the innumerable proofs of His beneficent design. The extensive importance of the date-tree is one of the most curious subjects to which a traveller can direct his attention. A considerable part of the inhabitants of Egypt, of Arabia, and Persia, subsist almost entirely upon its fruit. They boast also of its medicinal virtues. Their camels feed upon the date-stones. From the leaves they make couches, baskets, bags, mats, and brushes; from the branches, cages for their poultry, and fences for their gardens; from the fibres of the boughs, thread, ropes, and rigging; from the sap is prepared a spirituous liquor; and the body of the tree furnishes fuel; it is even said, that from one variety of the palm-tree, the *Phœnix farinifera*, meal has been extracted, which is found among the fibres of the trunk, and has been used for food.

THE PALMETTO.—A beautiful species of this tribe grows in the West-Indies to be a very large tree: with the leaves the inhabitants thatch their houses; and these leaves, before they are expanded, are cut and brought into England, to make women's plaited hats; and the berries of them were formerly much used for buttons. The Palmetto is thus characterized by Gay:

> Like the tall palm it shoots its stately head;
> From the broad top depending branches spread;
> No knotty limbs the taper body bears:
> High on each bough a single leaf appears;
> Which, shrivell'd in its infancy, remains
> Like a clos'd fan, nor stretches wide its veins;
> But, as the seasons in their circle run,
> Opes its ribb'd surface to the nearer sun:
> Beneath the shade the weary peasant lies,
> Plucks the broad leaf, and bids the breezes rise:
> Thus artificial zephyrs round him fly,
> And mitigate the fever of the sky.

PALMA CHRISTI, (*ricinus.*)—The male calyx is quinquepartite; no corolla; the stamina numerous. These female calyx is tripartite; corolla, but three bifid styles, with a trilocular capsule and a single seed. The communis, or common Palma Christi, is of speedy growth, as in one year it arrives at its full height, twenty feet. The trunk is subligneous; the pith large; the leaves broad and palmated; the flower-spike simple, conical, and thickly set with yellow blossoms; the capsules are triangular

Date
American Aloe
Cocoa Nut
Mosquito Fly
Palm

and prickly, containing three smooth grey mottled seeds. When the bunches begin to turn black, they are gathered, dried in the sun, and the seeds picked out; they are afterwards put up for use as wanted, or for exportation.

The Ricinus Americanus grows as tall as a little tree; and is so beautiful that Millar planted it himself, at Chelsea. It expands into many branches; the leaves are sometimes two feet in diameter, and the stem as large as a middle-sized broom staff; towards the top of the branch is a cluster of flowers, resembling a bunch of grapes, small and staminous; but on the body of the plant grow bunches of rough, triangular husks, each containing three speckled seeds, less than horse-beans; the shell is brittle, and contains white kernels, of a sweet, oily, and nauseous taste. From this kernel the oil is extracted; the plant grows wild, and in great plenty in all the British and French American islands.

Castor-oil is obtained either by expression or by decoction. It is best prepared thus: A large iron boiler, half filled with water; the nuts are then beaten in deep wooden mortars, and thrown into it; the fire is lighted, and the liquor gently boiled for two hours, and constantly stirred. About this time the oil begins to separate, and swims on the top, mixed with a white froth, and is skimmed off till no more rises. The skimmings are heated in a small iron pot, and strained through a cloth. When cold it is put up in jars or bottles for use.

THE LEMON-TREE

HAS an upright smooth trunk, divided upward into a branchy regular head; from twelve to fifteen feet high; large, oval, spear-shaped, pointed, slightly sawed leaves, on linear footstalks; and many flowers from the sides of the branches succeeded by large oval fruit prominent at the top. The varieties are, the lemon-tree, with sour fruit; with sweetish fruit; with very large fruit, called Imperial Lemon; with spear-shaped fruit; with furrowed fruit; with clustered fruit; with childing fruit; with whitish fruit; with tri-colour striped fruit; with silver striped leaves; and with double flowers.

THE ORANGE-TREE

In the soft bosom of Campania's vale,
When now the wintry tempests all are fled,
And genial summer breathes her gentle gale,
The verdant orange lifts its beauteous head;
From every branch the balmy flow'rets rise,

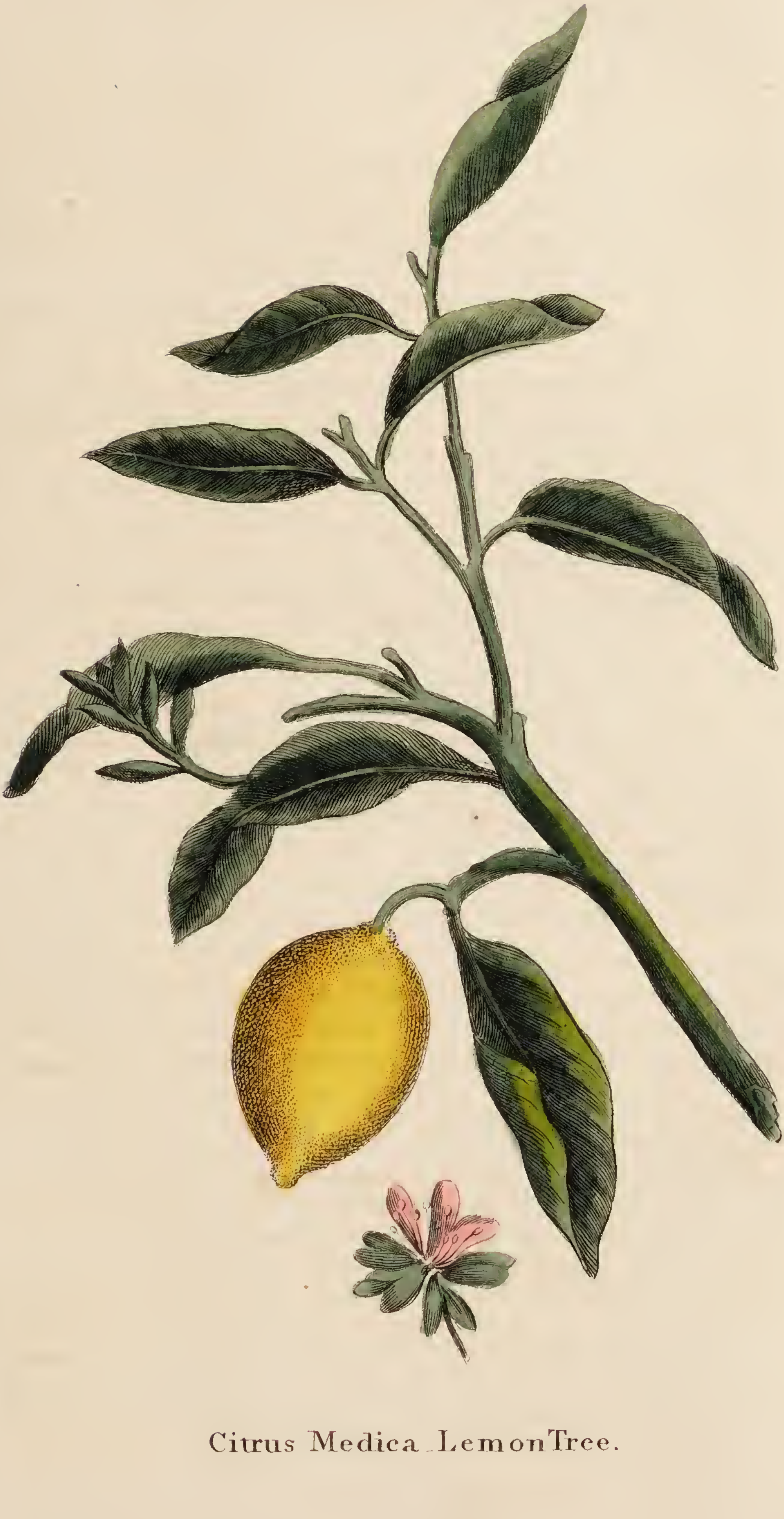
On every bough the golden fruits are seen;
With odours sweet it fills the smiling skies
But, in the midst of all its blooming pride,
A sudden blast from Apenninus blows,
Cold with perpetual snows;
The tender blighted plant shrinks up its leaves, and dies.

LYTTLETON.

HAS an upright trunk, dividing upward into a branchy, regular head, from five to ten or twelve feet high; oval, spear shaped, entire leaves, having winged footstalks, and numerous white flowers at the sides of the branches, succeeded by globular fruit compressed at both ends.

The JAPANESE CITRON grows naturally in Japan, where it is named Gees, and Karatals banna. The branches and shoots are unequal; in some parts compressed, in others swelling, especially about the spines. These proceed singly from the stem and branches; are straight, run out from a broad base into a very sharp point; and are protruded from the wood, invested with the common bark. The wood is loose and soft; the bark of a shining green, moist, and easily parting from the wood. The leaves are sawed on the edges, veined, placed without order, but generally under the spines. They grow by threes, like those of trefoil, upon the extremity of a common footstalk, furnished on each side with a membranaceous fringe, resembling the pedicles of the orange. The upper surface of the leaves is of a bright lucid green, the lower dark and herbaceous. The flowers resemble those of the medlar, and proceed singly from the arm-pits of the leaves; white, of five petals, possessed of not much fragrance. The fruit is equally beautiful with a middle-sized orange; their internal structure also much the same; the pulp is glutinous, of an unpleasant smell, and a harsh disagreeable taste. The seeds have the same taste with the pulp, and are shaped like those of the orange.

The three first species are elegant evergreens, rising in this country from five to ten feet in height; forming full and handsome heads, ever closely garnished with beautiful large leaves, and putting forth a profusion of sweet flowers in spring and summer; even succeeded by fruit that sometimes arrives at tolerable perfection. All the varieties were obtained by seed; yet the only certain method of continuing the approved varieties, is by budding on stocks raised from seed to a proper size.



Citrus Medica _ Lemon Tree.

London Published by Sir R. Phillips & Co. Feb 10. 1823.

Neele & Son 352 Strand

The budding is performed in August, the buds being taken from good trees, that bear well. When the operation is finished, the plants are placed in the green-house; or in a spare bark-pit, where the heat is almost exhausted, for two or three weeks; the air must be admitted freely by the front glasses, slightly shaded by mats from hot sunshine, and supplied with water every two or three days. In four weeks the buds will be united with the stock; when the bandages are loosened, that they may swell; the buds, however, will remain dormant till spring.

As the young trees, however, are brought in plenty from abroad, this method is seldom practised. The most cheap and expeditious method of procuring these trees, is from such as are imported from Spain, Italy, and Portugal, sold in the warehouses from three shillings to a guinea each. They first are planted in pots of light rich earth, and plunged in a tan-bed, for three or four months; then they are trained to the open air, but bear it only from May till October.

Sometimes they are planted in the ground, by far the most eligible method; with frames erected for the support of glass and other covers, to defend the plants during inclement weather; in this situation the trees generally shoot strong, produce large fruit, and may be trained either as standard trees, or against a south wall, in a dry situation, with a wooden frame-work sloping, to support glass frames, for winter. For standards, a capacious and lofty glass-case is erected, in the manner of a hot-house; one or two rows of orange-trees run up as standards, with only pruning to preserve their regularity. Some persons have lofty moveable glass-cases, so that two or three rows of trees are planted in a conspicuous part of the pleasure-ground; in winter covered, and in summer wholly exposed, so that they form a little orange-grove in the open ground. The flowering and fruit-setting season is in June and July. They are often, especially the orange-trees, greatly loaded with blossoms; and when very thick, the smallest are taken off. Also, as the trees continue blowing and setting their fruit for three months; when a full crop of fruit is set, gather off the superabundant blossoms as they are produced; though some remain, on account of their appearance.

Orange-flowers are one of the finest perfumes; though little used in medicine. The fruit is cooling, and good in feverish disorders, and particularly in diarrhoeas. Orange-peel is an agreeable aromatic, proper to repair and strengthen the stomach, and gives a very grateful flavour to infusions or tinctures. It is particularly useful in preparations of bark; gives an agreeable warmth to the infusion; and, Dr. Percival says, considerably increases its virtue. In a grove near Florence is a tree, having an orange stock so grafted upon, that its branches, leaves, flower, and fruit, are three-formed; emulating the orange, the lemon or citron, and some partaking these forms in one; yet these mixed fruits never produced any perfect seeds; they were either without seeds, or had only a few empty ones.

A kind of dew, extremely fine and subtile, falls in spring from the leaves of orange and lemon-trees. La Hire placed some flat pieces of glass under the leaves to receive it; and having procured some large drops, attempted to discover its nature. He soon found it was not a mere aqueous fluid, because it did not evaporate; and that it was not a resin, because it readily and perfectly mixed with water: it was then supposed a liquid gum; but this, on examination, did not prove to be the fact; for, being laid on paper, it did not dry as liquid gums do. Its not answering to these characters, and being of the consistence of honey, and of a sweet sugar like taste, gave a suspicion of its being a kind of manna.

SUGAR.

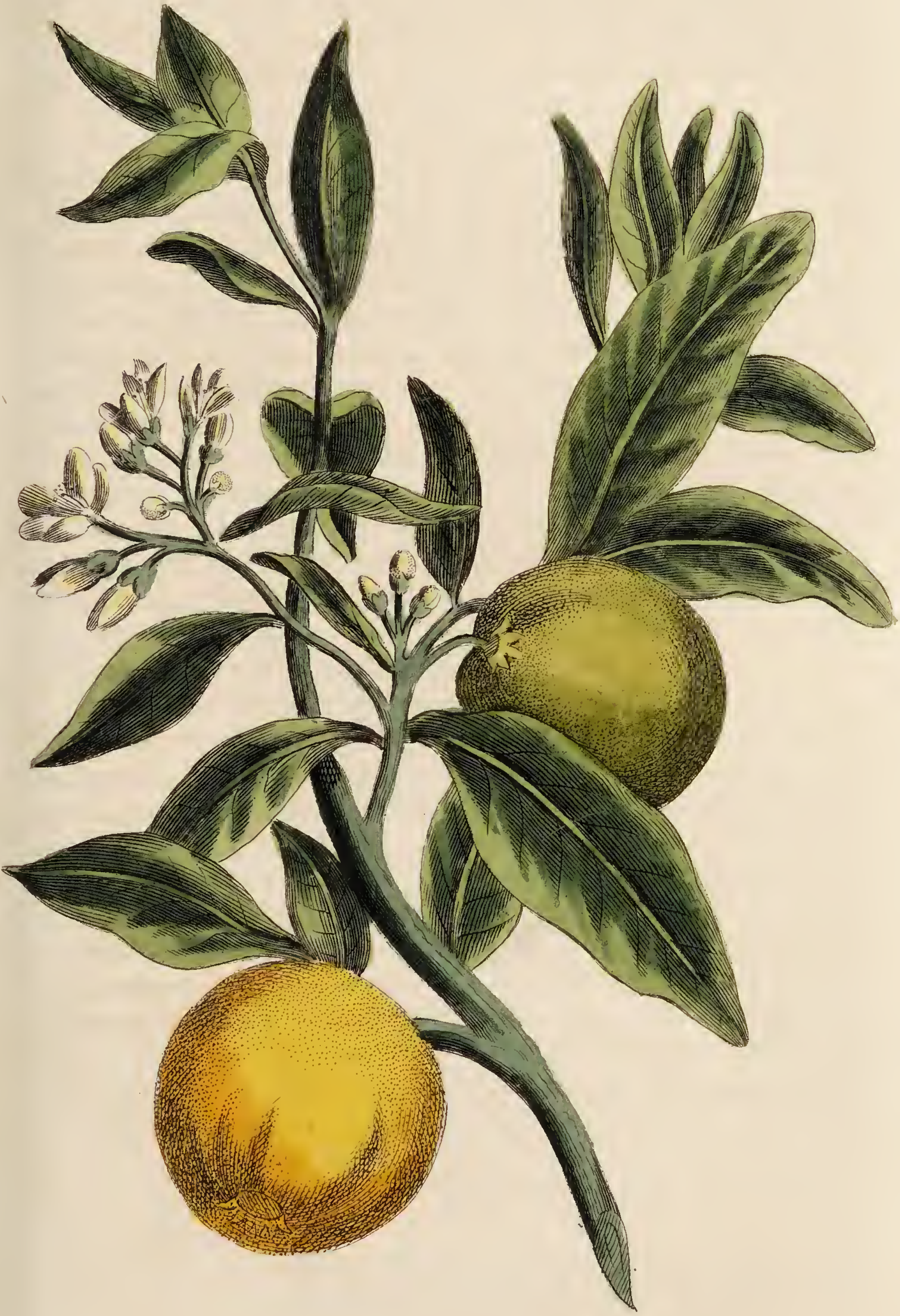
THE sugar-cane requires a rich soil, and of which the mould is at least one foot in depth. It should also be free, for clayed land, and all others where the water filtrates with difficulty, yield meagre canes, the sugar of which will not defray the expense of their cultivation. The sugar prefers rather a fat and ash-coloured soil.—Three species of sugar-cane can be distinguished even at a distance, by the colour of their leaves; namely, the ancient Creole sugar-cane, the Otaheite cane, and the Batavia cane.

The first has a leaf of a deeper green, the stem less thick, and the knots nearer together. This sugar-cane was the first introduced from India into Sicily, the Canary Islands, and the West Indies.

The second is of a lighter green; and its stem is higher, thicker, and more succulent. The whole plant displays a more luxuriant vegetation. We owe this plant to the voyages of Bougainville, Cook, and Bligh. Bougainville carried it to the Isle of France, whence it passed to Cayenne, Martinique, and since 1792 to the rest of the West India islands.

The third species, the violet sugar-cane, called Cana de Batavia, or de Guinea, is certainly indigenous in the island of Java, where it is cultivated in preference in the districts of Japara and Pasuruan. Its foliage is purple, and it is preferred in Caracas for rum.

The sugar-cane is propagated by itself. When it is cut to be passed through the mill, about one foot from its top is lopped off for the purpose of planting. The place assigned for the plantation is then marked out into squares, something like our gardens, that by planting them successively the canes of each square may ripen in the same order, allowing time to each to be cut, and the sugar fabricated, without the other canes suffering.



Citrus Aurantium _ Orange Tree.

London. Published by Sir R. Phillips & C°. Feb. 10. 1823.

Neele & Son 352 Strand

For planting the cane, holes are made with a hoe, which are fifteen inches long, ten wide, and six deep. In this work, which is the most laborious appertaining to the sugar-plantation, only male negroes and the most robust negresses are employed. Three cane-plants are laid in each hole, and they are covered with only three inches of earth, and without pressure.

The sugar-cane ripens according to the season it experiences: rains retard, drought accelerates its maturity. Much depends also on the nature of the soil. In rich and moist lands the cane does not ripen under sixteen or seventeen months, while, in a light soil, it ripens two months earlier. In the ninth month, the plant begins to cast its leaves. Those nearest the foot of the cane fall first, and the others in succession; so that by the time the plant arrives at maturity, the cluster of leaves which terminates it alone remains. At the same time the cane assumes a yellow colour, an infallible sign of the good quality of the sugar it contains. It is not thus with the canes of marshy lands, and hollows or bottoms; they retain the green colour, whatever may be their age, and thus announce to the refiner the difficulty he will experience in obtaining the sugar.

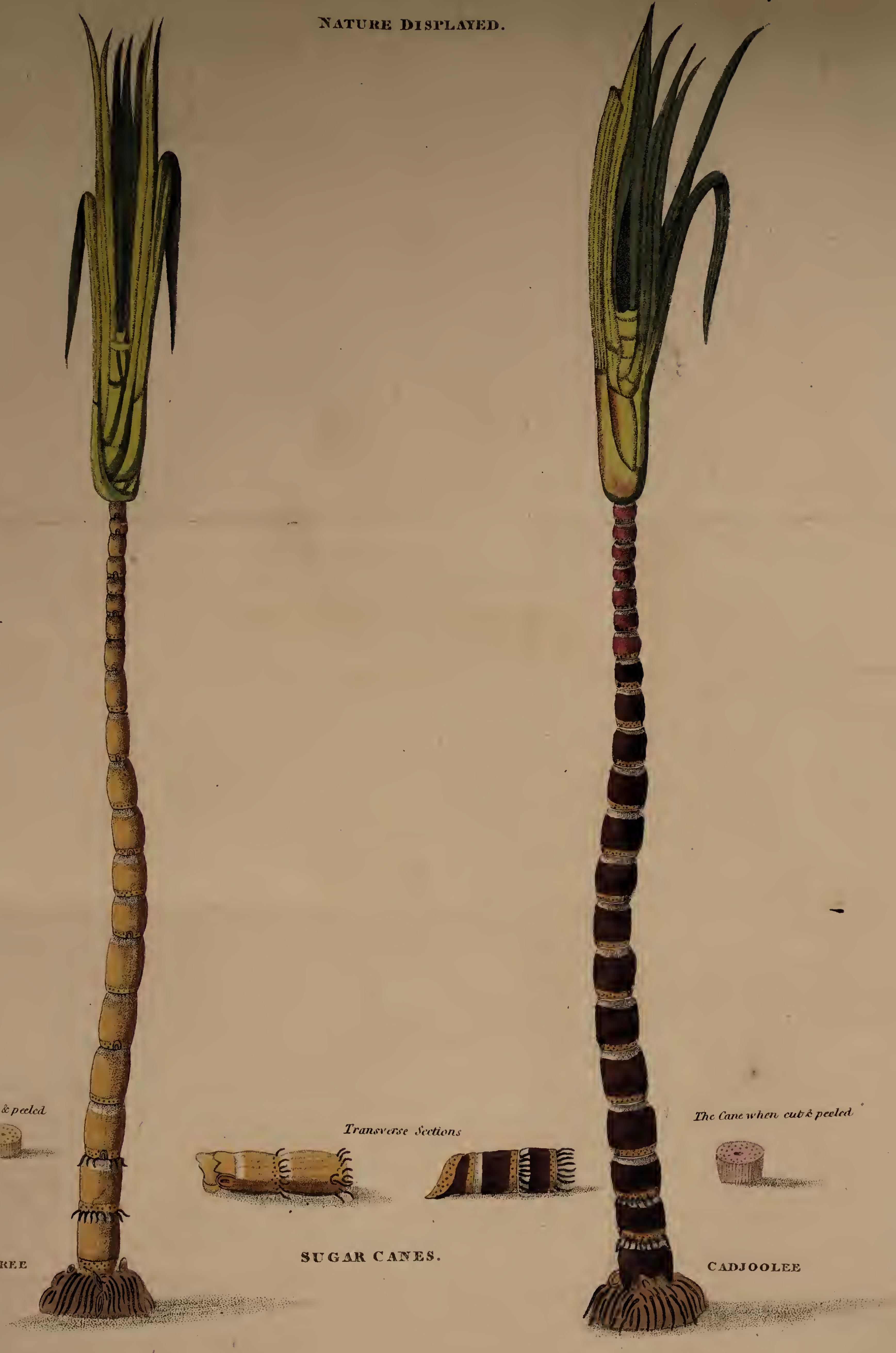
The sugar-cane is cut with a bill very near the root, and at a small distance from the cluster of leaves at the summit. A piece of the tender part of the cane, near the summit, is then retained for the purpose of planting. After the large canes, or the first which proceed from the plant, are removed, the young shoots are left, and require only weeding and fair weather. Good land furnishes as many as five crops of shoots; that is to say, a plantation of canes may be cut five times without replanting. At each cutting, however, the quantity of sugar is less. A piece of cane, which yields, at the first cutting, seven hundred forms of rough sugar, each weighing fifty-four pounds, will give from its first shoots only six hundred forms; the second shoots, five hundred; the third, four hundred and twenty, and so on in like proportion.

The labours of the sugar-plantation must be so distributed, that the different operations go on at the same time. While some negroes cut the canes, others convey them to the mill, where they are ground as fast as they arrive. The juice extracted from the cane is immediately subjected to the process for converting it into sugar. Every thing must be done at once. If the sugar-cane is not pressed as soon as cut, it undergoes a fermentation, which affects the saccharine parts, rendering the manufacture very difficult, and the results less favourable. If the juice of the cane be not exposed to the fire as soon as expressed, it contracts a degree of acidity which greatly embarrasses the refiner. The West India colonists are so well convinced of the celerity requisite in these different operations, that, from the moment when they begin to cut the cane, the labours of the plantation continue night and day. The negroes are divided into four companies or relievers, like sailors in the navigation of a vessel, and there is no intermission except on Sunday.

The mill for expressing the canes is composed of three iron cylinders. One in the centre, to which the moving power is applied, turns the other two, by means of teeth of iron or wood, at the upper parts of the three cylinders. These mills are worked by water or by mules. The former unites the valuable advantages of celerity and economy of animals. One water-mill, constructed with accurate dimensions, will furnish in twenty-four hours sufficient juice of the cane for a hundred and sixty forms of rough sugar, each weighing fifty-four pounds, unless poverty of soil or an unfriendly season should present impediments.

The juice of the cane passes directly from the mill, through a canal, into a large basin, which is placed in the sugar-works, by the largest of five caldrons. The first caldron is the largest, usually fifty-four inches in diameter. It is in the last that the sugar receives the last degree of boiling. These caldrons are placed in the same line, and by the side of each other: they are fixed in mason-work over a stove or kiln, the focus of which is under the last, and from which a canal passes beneath the five caldrons, allowing the smoke to escape through a chimney by the side of the largest. The whole apparatus of these caldrons is in general placed behind the wall of the sugar-house.

As soon as the boiling is sufficient, the fire is checked, that the sugar may be removed, without experiencing


The Cane when cut & peeled
Transverse Sections
The Cane when cut & peeled
POOREE
CADJOOLEE

SUGAR CANES.

more ebullition at its own expense. This advantage cannot be obtained with wood of any kind; for it deposits in the furnace a bed of ardent coals, which maintains the violence of the fire much longer than is necessary, and reduces to a candied state that part of the sugar which is more immediately at the bottom of the caldron.

Some chemists maintain, that the heterogeneous terials of sugar are a fecula, or sediment, an extract, and a colouring matter, which become separated by evaporation. Others think that it is only necessary to obtain, by simple evaporation and the action of fire, a diminution of the water, and a reunion of the particles of sugar, thus facilitating the coagulation and separation of the feculæ and the colouring matter. There are some who consider sugar as a saline substance, and as holding a middle station between mucilage and essential salts. Engish planters reckon it eight parts of water, one of sugar, and one of thick oil and mucilaginous gums, with a portion of essential oil; and it is on these principles that they manufacture sugar.

French colonists merely suppose that the juice is composed of a great portion of superabundant water, which evaporates by ebullition, and some acids or mucilages, from which it is necessary to disengage the saccharine part. To produce neutralization, they oppose to those acids a proportionate quantity of alkali, in order that the effervescence made by the alkali with the acid, assisted by ebullition, may exhibit them under the form of a saponaceous scum, which is removed with skimmers made for that purpose.

One negro at least to each caldron is constantly employed in removing the scum; and frequently one is not sufficient. The skimmer performs without dispute the most important part in the manufacture of sugar. From his activity results the good or bad quality. All the other conditions necessary to produce handsome sugar will be of no avail, if it is badly skimmed. This operation is begun in the second caldron; sometimes, but rarely, in the first.

The talent of boiling sugar well is very highly appreciated in the colonies, as on the just degree of it depends the ultimate fate of the article. If the boiling be too violent, a part of the essential salt burns and diminishes the quantity, and the excessive union (or consolidation) of the particles resists the process of claying; for the molasses, which it is necessary to extract in whitening, forms with the sugar a substance which the water used in purification cannot penetrate. If the boiling is too feeble, the incrustation of the sugar is imperfect, and the water used in claying, not finding the necessary resistance, carries off much of the sugar in the form of syrup. Each form of rough sugar weighs, in the French colonies, fifty-four pounds. It is reduced to forty-one or forty-two by the process of claying; but if the sugar is not sufficiently boiled, and the process of claying is attempted in the same manner as though it had been well boiled, it is reduced to thirty-two or thirty-three pounds. For this reason, when it is intended to sell the sugar in its rough state, it must receive a greater degree of boiling than when it is to be clayed.

The mode of ascertaining the boiling of the sugar is simple and infallible. One of the large copper ladles, used to decant the juice, is plunged into the fifth caldron, and immediately withdrawn. By the quantity of the syrup which adheres to the sides of the ladle, the degree of thickness is perceived. When this sign indicates that the point of boiling approaches, the ladle is replunged, and as much of the article taken from the back of it as the thumb can carry; the index, or forefinger, is then applied to this portion of the liquid; at the same time the thumb is dropped and the index elevated. The syrup forms a thread, which should break when the fingers are two inches apart, and retire on itself in form of a cork-screw, toward the matter remaining on the thumb. This is called with reason the proof, for there is in fact none better. The feebleness of the boiling is known by the difficulty with which the thread forms; its excess, by the difficulty with which the thread retires when broken. As soon as the desired indication is obtained, the fire is checked and the sugar promptly drawn off. Two negroes, and sometimes three, each having a ladle of ten or twelve feet, empty the sugar, at once, into a caldron placed under the ground of the sugar-house, by the side of the fifth caldron.

After half an hour the sugar is stirred in this new caldron, that it may granulate equally. For this purpose a wooden spatula, nearly three feet long, called *mouveron*, is used. The sugar is presently removed from this caldron to another, larger and more distant from the apparatus, where it is left till it forms an ice or crust, a line in thickness. This crust shows both the quality of the sugar, and the degree of boiling. If it be green toward the centre, the sugar is not good; if it be too friable, or brittle, the sugar is too much boiled; if not sufficiently so, the boiling has been too feeble.—The just point of boiling has been acquired, when, applying the hand lightly to the crust, it bends and resumes its level. If it break too easily, the boiling was in excess; if it do not resume the level, the boiling was deficient.

While the sugar is in this caldron, large earthen moulds or forms are placed in the sugar-house, at a distance from the apparatus, having been kept two or three hours in water, and well-washed. They are placed beside each other, the point down, the hole at the point being carefully closed with a stopper of straw. As many forms are employed as are supposed sufficient to contain the matter that has been boiled: the sugar is then put in them while still liquid. This operation has also its particular mode. For this purpose a copper pan, with two handles, and of convenient form, is employed. It contains nearly four pots of liquid, and is filled with the article to be transposed. The negro who performs this task is careful not to empty the pan into one mould, but to distribute it among several, so that they may be filled at the same time. This precaution is necessary, that the liquid part of the sugar may not be contained in some forms, and all the grain in others, but that the distribution may be perfectly equal.

After an hour has elapsed, the sugar in the moulds, still in a state of liquefaction, requires another stirring, not less essential than the preceding. The object is to remove the grain of the sugar which has adhered, through its own weight, to the bottom and sides of the mould, and to divide it equally throughout the mould, precisely at the moment when the cooling of the contents gives to the sugar such consistence as will prevent the grain from precipitating anew. The success to be expected from this operation, depends entirely on the moment in which it is performed. It is called stirring the sugar. If the sugar be too warm, it disturbs the harmony of the formation of the grain, and removes without advantage that which is deposited at the bottom, and on the sides, to the mould. If it be too cold, it has already become too thick to answer the wish of the refiner.—A handsome golden colour announces that the sugar has been well manufactured, and well boiled; a pale yellow discloses the deficiency of alkali, and of boiling; dark yellow shows the excess of both.—When the sugar is perfectly cold, the forms, or moulds, are removed from the sugar-house to the place of purification, where they are placed on large earthen pots, with narrow openings, called *canaris*. But previously, the stopper of straw which closed the opening at the point of the form, is not only removed, but the contents is also pierced with a peg or pin, a foot and a half in length, which is immediately withdrawn.

The sugar is left to drain on the canaris, during five or six days; after which it undergoes the process of claying. The whole of the fountain, or crust on the surface, is removed. The sugar is well mixed with a kind of trowel, and a layer of sugar already blanched is placed on it, which is united with it as well as can be effected without pressure. The vacancy of about two inches, remaining in the form or mould, is then filled with a paste of black earth, well divided. The water which drains from this earth penetrates throughout the form, and conveys with it into the canari all the molasses to be carried off. When this earth becomes dry, water is poured on it. This is called giving it a refreshment. The sugar generally receives two supplies of earth, and to each two refreshments.

After the last earth is removed, the sugar is left to drain during twelve days. A fine day is then chosen for exposing it to the sun, from ten until three o'clock. For this purpose it is removed from the form or mould. This is called loosening the sugar. The form is placed on straw, with the small end uppermost; it is then struck with both hands so gently as not to break the form, or bruise the sugar, but with sufficient force to detach it. This generally happens about the third or fourth stroke. The sugar is exposed to the sun, that it may acquire a consistence which will bear handling without being broken. After three o'clock it is carried to the stove. This is a building of masonry, twenty feet square, more or less, and thirty feet high, without other opening than a small door which closes hermetically, and which opens into the place of purification. It bears some resemblance in form to a tower of our country steeples. In one of the exterior sides there is an opening two feet square, even with the ground, to which is adapted, in masonry, a canopy of beaten iron, of which all the cavity is within the stove. In this place the fire and the wood are put, which it is necessary to nourish both day and night. The smoke escapes by the same avenue through which the fuel is supplied, in order that it may not penetrate the stove. The heat is kept up to the one hundred and fortieth or fiftieth degree of Fahrenheit's thermometer. In the interior, three or four stages of boards, arranged in the form of a grate, or lattice, are prepared, on which the sugar is placed. Twelve or fifteen days are sufficient to give it a solidity which it will retain two or three years, provided it is preserved from water and excessive humidity. When the sugar is removed from the stove, it is broken or pounded, put up in hogsheads, and delivered in commerce.

THE COFFEE-TREE.

All land within the extent of five degrees crossed by the line is suitable for the cultivation of coffee, excepting land composed of hard and cold clay, or light and sandy ground on a bed of marl. The leaves of the coffee planted in such soils turn yellow, and the tree perishes or is barren. It requires, in preference, a soil new and free, a little elevated, where the coolness and the rains moderate the excessive heat of the torrid zone, which would overpower the plant if exposed to all its violence.

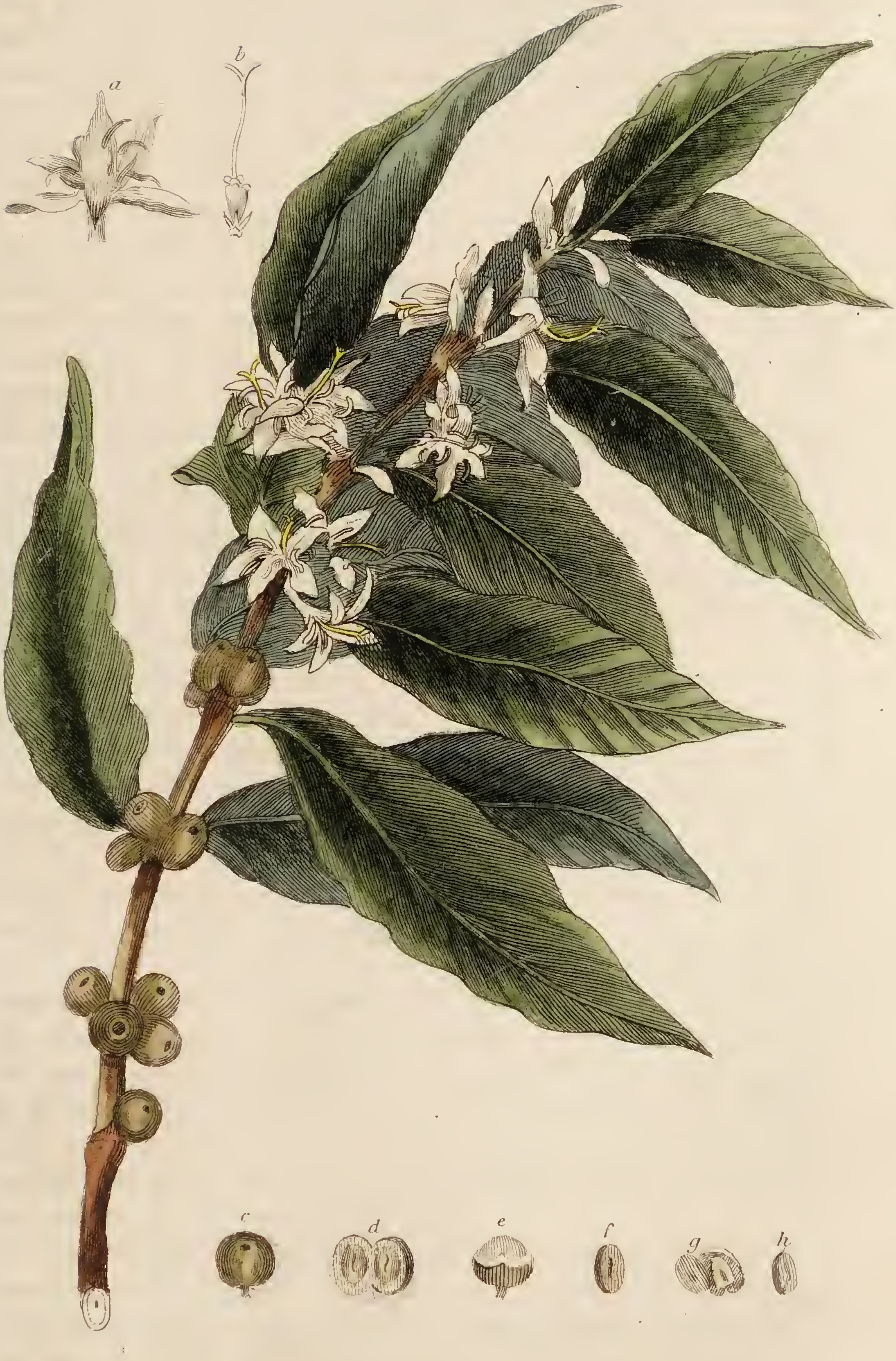
The *coffea arabica*, or eastern coffee-tree, seldom rises more than sixteen or eighteen feet high, in its native country; the main stem grows upright, and is covered with a light brown bark; branches horizontal, opposite, brachiate at every joint, long, simple, or undivided, slender, smooth, lax, and inclined to bend downwards; the lower ones longest, the others gradually decreasing to the top, so as to form a pyramid. The leaves generally continue three years. The flowers are produced in clusters (two to four) at the base of the leaves, sitting close to the branches; they are of a pure white, with a very grateful odour, but of short duration, and they are succeeded by berries, which are first green, but turn red when fully grown, and change to black when ripe. They are of an oblong spheroidal form, with a little circular area at the top, within which is a callous dot; the pulp is pale, insipid, and gelatinous; within it is two-celled, and the partition is fleshy and vascular; this is the only receptacle, and penetrates the cleft of the seeds.

The land destined for the coffee being well cleared, holes are made for the new plant, in such order as the planter may think proper, and at the distance required by the ground. A square of ground planted in triangles of seven plants, gives two thousand nine hundred and twenty-six coffee plants; if in squares of seven plants, it only gives two thousand five hundred; if in squares of ten, it gives twelve hundred and twenty-five; if in triangles of ten, it yields fourteen hundred and forty-one. It is important to fruitfulness that the plants should be lopped off at a certain height, regulated by the quality of the soil. In the poorest land they are trimmed at two feet and a half, and in the best at four or five feet high.

Between the ranges of the young coffee-plants, sufficient vegetables may be raised for the consumption of the plantation. The prudent planter never fails to avail himself of the advantage which a cultivated soil offers, for having all vegetables he has occasion for, without any further trouble than that of planting them.

Unless great contrarieties happen in the season or the soil, the coffee-plants give a light crop in the second year, and are in full bearing in the third. Each plant yields according to the nature of the soil. At San Domingo they calculate one pound to a plant; at Jamaica, one pound and a half; and at Tierra Firme, two pounds.

Several causes are injurious to the coffee harvest.—



Neele & Son, Strand.

COFFEE TREE.

London, Published by Sir R. Phillips & C°. Feb. 10. 1823.

Drought is one. The plant requires much rain, excepting during the time of blossoming, for then the rains destroy the flowers and all prospect of fruit. A too great quantity of cherries, with which the tree is loaded, is another. The tree cannot furnish sufficient of the nourishing juices for this superabundance of fruit; many grains are therefore spoiled.

The country entitled to the highest rank in the culture of coffee is Arabia Felix. Either from the superiority of its soil, or from the method observed there in preparing this article of produce, or perhaps from both, the coffee of this country commands three times the price of that of any other. The mere denomination of Mocha coffee commands this superiority. The preparation which it receives exacts, it is true, cares too minute and tedious to be entirely suitable to considerable plantations; but they are not, therefore, the less necessary to be known, that the principles may be adopted on which they are founded, and that they may be observed as far as localities will permit.

The plantations are in a moist shady situation, on a small eminence, at the foot of the mountains, whence little rills of water are conducted in small channels to the roots of the trees, to secure the production and ripening of the fruit. When they remove or transplant a tree, they make a trench three feet wide and five feet deep, which they line or cover with stones, that the water may the more readily sink deep into the earth, and thus be kept from evaporating. When the fruit is nearly ripe the water is turned off, lest the fruit should be too succulent. In places much exposed to the south the coffee-trees are planted in regular lines, sheltered by a kind of poplar-tree, which affords a thick shade. Without this precaution they suppose that the blossoms would be so parched by the excessive heat of the sun, as not to be succeeded by fruit.

"When the Arabian cultivator, (says Mr. Bryan Edwards,) sees that his coffee is ripe, he spreads large cloths over the trees, which he shakes from time to time to make the ripe cherries fall. He never pulls one grain of coffee with the hand, whatever appearance it may have of maturity: He considers none as ripe, but such as fall on lightly shaking the tree. This process, more or less rigorously observed, serves at least to confirm the principle, that perfect maturity is an essential requisite for obtaining good coffee.

The grains thus gathered are exposed to the sun on mats with their pulps, until they are perfectly dry; which requires a long time. Their dry envelope is then removed by means of a large stone cylinder, and they are replaced in the sun; for the planters of Yemen are persuaded that the coffee is apt to ferment, as long as it retains any particle of humidity. It is then winnowed, and packed in bales for merchandise. This practice indicates, that the coffee can never be too dry.

The coffee is dried in two ways: the first is to place the cherries in the sun, in layers of four inches thick, on sloping terraces, or on inclined platforms. They ferment in a few days, and the pulp discharges itself in the fermentation. The coffee is thus left until it is entirely dry, which is not less than three weeks. The skin of the cherries already broken is removed by mills made expressly for that purpose. In default of mills recourse is had to mortars. The coffee, thus prepared whatever be its quality, weighs five per cent. more than that which has received a different preparation. It still remains to strip the grain of coffee from the pellicle with which it is immediately covered, and which is called parchment. For this also use is made of mills, which art, animated by interest, is simplifying and perfecting every day. Nothing further is wanting, than to winnow the coffee mingled with the grinding and dust of the parchment. This is effected by mills, of which the mechanism varies according to circumstances and judgment. The coffee is then put in bags, and sent for sale to the nearest sea-port.

The coffee-tree bears flowers only the second year, and its flowering lasts only twenty-four hours. At this time the shrub has a charming aspect; seen from afar, it appears covered with snow. The produce of the third year becomes very abundant. In plantations well weeded and watered, and recently cultivated, we find trees bearing sixteen, eighteen, and even twenty pounds of coffee. In general, however, a produce of more than a pound and a half, or two pounds, cannot be expected from each plant.

The natural height of the coffee-tree is from fifteen to eighteen feet; and, if left to itself, it would have the form of most other trees, *i. e.* a naked trunk and a branchy head. This is prevented by what the planters call stopping, which is performed by cutting off the top of the tree when it has arrived at the proper height, which varies according to circumstances. In the best soil, and most genial exposure, it is suffered to grow to the height of five feet, and in the worst stopped at two.

The liquor which we call coffee, prepared from the berry of this tree, is said to have been drunk in Ethiopia from time immemorial.

Two English travellers notice this beverage at the beginning of the seventeenth century: Biddulph, about 1603, and William Finch, in 1607. The former says, "The Turks have, for their most common drink, coffa, which is a black kind of drink, made of a kind of pulse like pease, called *coava*." The latter, that "The people in the island of Socotora have, for their best entertainment, a china dish of *coho*, a black bitterish drink, made of a berry like a bay-berry, brought from Mecca, supped off hot."

The first plant which appeared in Jamaica was carried there in 1720, and, in the year 1752, the export of coffee from Jamaica was rated at 60,000 pounds weight. The Abbé Raynal says, that 12,550,000 pounds weight is annually exported from Arabia Felix. In Jamaica, the coffee-tree thrives best in a rich soil, and cool shaded situation, where it produces so great a quantity of fruit that the branches can hardly sustain the weight, and even the very trunk yields to the load. This fruit is large and succulent, and the berries lax and clammy; they are gathered when only half ripe; and, instead of being stripped of their pulp, and the seeds being carried down to the low lands to be dried, they are left soaking in their clammy juices, to dry slowly in a damp air. This alone will sufficiently account for the supposed inferiority of the Jamaica coffee to the Arabian, which grows in a sandy, dry, hot soil, where the berries have but little pulp, and are soon dried, spread upon mats, and exposed to the sun.

While the honour of introducing tea may be disputed between the English and the Dutch, that of coffee remains between the

English and the French. Yet an Italian intended to have occupied the place of honour; that admirable traveller Pietro della Valle, writing from Constantinople 1615, to a Roman, his fellow-countryman, informing him that he should teach Europe in what manner the Turks took what he calls "*Cahué*," or as the word is written in an Arabic and English pamphlet, printed at Oxford 1659, on "the nature of the drink *Kauhi* or Coffee." As this celebrated traveller lived to 1652, it may excite surprise that the first cup of coffee was not drank at Rome: this remains for the discovery of some member of the "Arcadian Society." Our own Purchas, at the time that Valle wrote, was also "a Pilgrim," and well knew what was "*Coffa*," which "they drank as hot as they can endure it; it is as black as soot, and tastes not much unlike it; good they say for digestion and mirth."

It appears by Le Gran's "Vie privée des François," that the celebrated Thevenot, in 1658, gave coffee after dinner; but it was considered as the whim of a traveller; neither the thing itself, nor its appearance, was inviting: it was probably attributed, by the gay, to the humour of a vain philosophical traveller. But ten years afterwards a Turkish Ambassador at Paris, made the beverage highly fashionable. The exotic beverage soon became a subject of conversation. We, however, knew the use before even the time of Thevenot; for an English Turkish-merchant brought a Greek servant in 1652, who, knowing how to roast and make it, opened a house to sell it publicly. The hand-bill has been discovered, in which he sets forth,

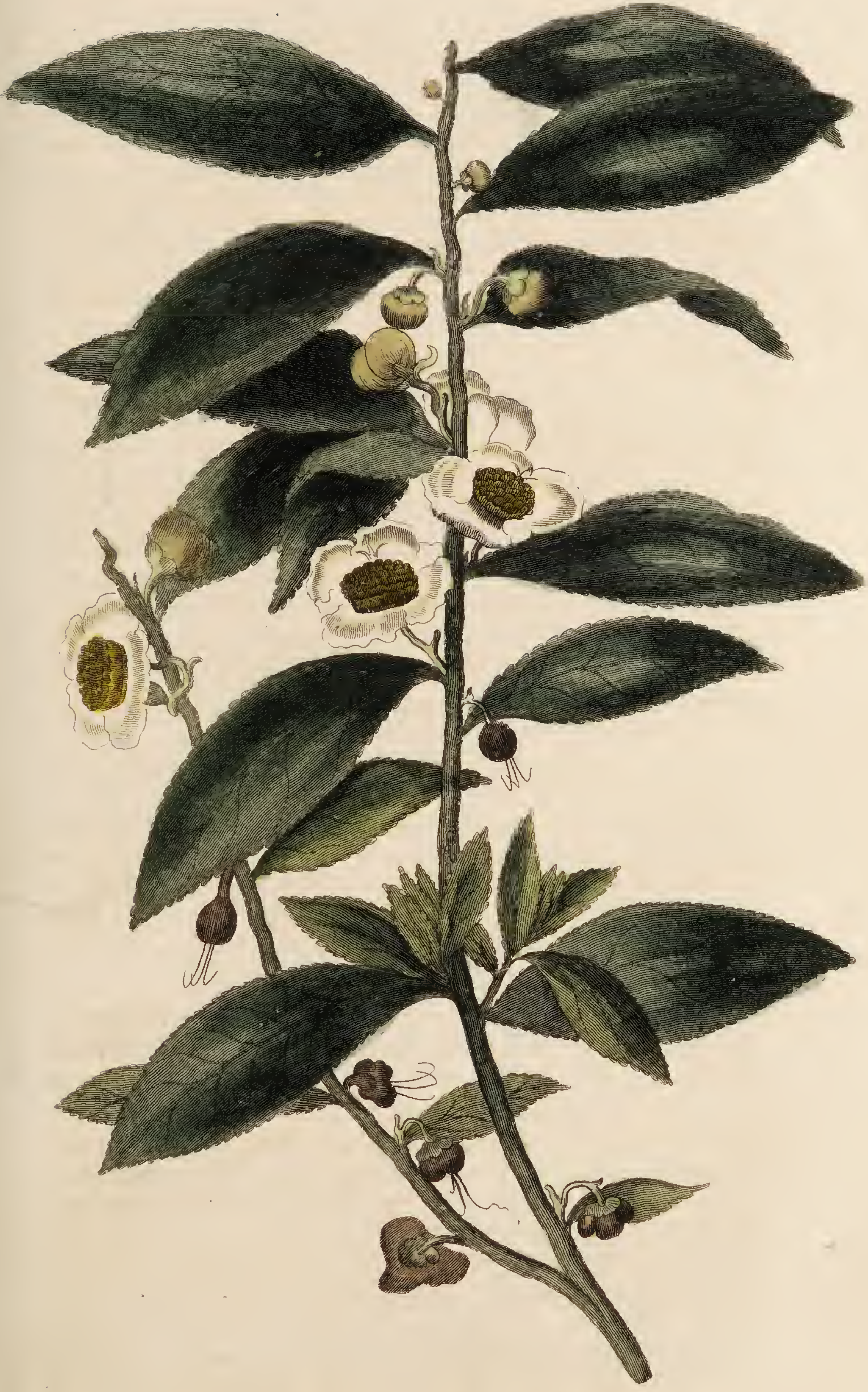
"The vertue of the coffee-drink, first publiquely made and sold in England, by Pasqua Rosee, in St. Michael's Alley, Cornhill, at the sign of his own head."

For about twenty years after the introduction of coffee in this kingdom, we find a continued series of invectives against its adoption, both in medicinal and domestic views. The use of coffee, indeed, seems to have excited more notice, and to have had a greater influence on the manners of the people, than that of tea.

TEA.

The tea plant is a native of Japan, China, and Tonquin, and does not grow spontaneously in any other parts of the world. Linnæus arranged it under the class of polyandria and order of monogynia. Sir Charles Thunberg, who resided sixteen months in Batavia and Japan, has given a full botanical decription of the tea-plant; and says expressly that it has only one style. Several British botanists refer it to the order of trigynia; deriving their authority from a plant in the Duke of Northumberland's garden at Sion-house, which had three styles.

According to Linnæus, there are two species of the tea-plant; the bohea, whose corolla has six petals; and



TEA TREE

Neele & Son 352 Stran

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the viridis or green tea, which has nine petals. Thunberg makes only one species, the bohea, consisting of two varieties; the one with broad, and the other with narrow leaves. The annexed engraving represents the bohea plant.

The tea-plant, which is an evergreen, grows five or six feet high, and at times ten or twelve. The leaves are about an inch and a half long, narrow, indented, and tapering to a point, like those of the sweet-brier and of a dark green colour. The root is like that of the peach-tree, and its flowers resemble those of the white wild rose. The stem spreads into many irregular branches. The wood is hard, of a whitish green colour, and the bark is green, with a bitter, nauseous, and astringent taste. The fruit is small, and contains several round blackish seeds, about the size of a bean or large pea.

This plant flourishes in the northern latitudes of Pekin, as well as round Canton, but attains the greatest perfection in the mild temperate regions of Nankin. It is found between the 30th and 45th degree of north latitude. In Japan it is planted round the borders of fields, without regard to the soil; but as it is an important article of commerce with the Chinese, whose fields are covered with it, it is by them cultivated with care. It grows equally well in a poor as in a rich soil; but in certain places it is of a better quality. The tea which grows in rocky ground is superior to that which grows in a light soil; and the worst kind is that produced in a clay soil. It is propagated by seeds; from six to twelve are put into a hole about five inches deep, at certain distances. So many seeds are sown in the same hole, because only a fifth part vegetate. Being thus sown, they grow without any other care.

The leaves are not fit to be plucked when the shrub is of three years' growth. In seven years it rises to a man's height; but as it then bears few leaves, it is cut down to the stem, and this produces a new crop of fresh shoots the following summer, every one of which bears nearly as many leaves as a whole shrub. Sometimes the plants are not cut down till they are ten years old.—There are three seasons in which the leaves are collected, in the isles of Japan, from which the tea derives different degrees of perfection. The first gathering commences at the end of February or beginning of March. The leaves are then small, tender, and unfolded, and not above three or four days old; these are called *ficki-tsiaa,* or "tea in powder," because it is pulverised; it is also called imperial tea, being generally reserved for the court and people of rank; and sometimes also it is named bloom tea. It is sold in China for 20d. or 2s. per pound. The labourers employed to collect it, do not pull the leaves by handfuls, but pick them one by one, and take every precaution not to break them. However long and tedious this labour may appear, they gather from four to ten or fifteen pounds a-day. The second crop is gathered early in April; when the leaves have attained their full growth, and the rest are not above half their size. This difference does not, however, prevent them from being all gathered indiscriminately.—They are afterwards picked and assorted into different parcels, according to their age and size. The youngest carefully separated from the rest, are often sold for leaves of the first crop, or for imperial tea. Tea gathered at this season is called *too-tsiaa.* or "Chinese-tea," because the people of Japan infuse it, and drink it after the Chinese manner. The third crop is gathered in June. The leaves are then very numerous and thick, and have acquired their full growth. This kind of tea, called *Ben-tsiaa,* is the coarsest. Some of the Japanese collect their tea only at two seasons of the year, which correspond to the second and third already mentioned: others confine themselves to one general gathering of their crop, towards June: however they always form afterwards different assortments of their leaves.

The finest and most celebrated tea of Japan, is that which grows near Ud-si, a small village close to the sea, and not far distant from Meaco. In the district of this village is a delightful mountain, having the same name, whose climate is favourable to the culture of tea; it is therefore enclosed by a hedge, and surrounded with wide ditches, which prevent all access to it. The tea shrubs on this mountain are planted in regular order, and divided by different avenues and alleys. The place is entrusted to people to guard the leaves from dust, and defend them from the inclemency of the weather. The labourers appointed to collect the tea, for some weeks previous, abstain from every kind of gross food, that their breath and perspiration may not injure the leaves. They gather them very carefully, and only touch them with fine gloves. When this choice tree has undergone the process necessary for its preparation, it is escorted by the superintendant of the mountain, and a strong guard, to the emperor's court, and reserved for the use of the imperial family.

As the tea shrub grows often on the rugged banks of steep mountains, of dangerous access, and sometimes impracticable, the Chinese, to come at the leaves, make use of a singular stratagem. These steep places are generally frequented by numbers of monkeys, which being irritated and provoked, to revenge themselves tear off the branches, and shower them down upon those who have insulted them. The Chinese immediately collect these branches, and strip off their leaves.

When the tea leaves have been collected, they are exposed to the steam of boiling water; after which they are put upon plates of copper, and held over the fire until they become dry and shrivelled, and appear such as we have them in Europe. There are public buildings erected for preparing the fresh gathered tea. Every private person who has not suitable conveniences, or is unacquainted with the operation, may carry his leaves thither as they dry. These buildings contain a number of small stoves, raised three feet high, each having a broad plate of iron fixed over its mouth. The workmen sit round a large table covered with mats, and roll the tea-leaves spread out upon them. When the iron plates are heated to a certain degree they lay on them a few pounds of fresh gathered leaves, which being green and full of sap, crackle as soon as they touch the plate. The workman then stirs them with his naked hands, as quickly as possible, until they become so warm that he cannot endure the heat. He then takes them off and lays them upon mats. The people employed in mixing them, roll a small quantity in their hands always in the same direction; others continually stir them, that they may cool sooner, and preserve their shrivelled figure longer. This process, necessary to extract all the moisture from the leaves, is repeated two or three times before the tea is deposited in the warehouses.

The people of Japan and China keep their tea a year before using it, because, when fresh and newly gathered, it possesses a narcotic quality which injures the brain. Imperial tea is generally preserved in porcelain vases, or in leaden or tin-cannisters covered with fine bamboo mats. Common tea is kept in narrow-mouthed earthen pots; and coarse tea, whose flavour is less easily injured, is packed up in straw-baskets.

The first European writer who mentions tea is Giovanni Botero, an eminent Italian, who, in 1590, published a treatise on the causes of the magnificence and greatness of cities: He does not indeed mention its name, but describes it so that it is impossible to mistake it.—"The Chinese have an herb out of which they press a delicate juice, which serves them for drink instead of wine; it also preserves their health, and frees them from all those evils which the immoderate use of wine produces among us."

Tea was introduced into Europe in 1610, by the Dutch East-India Company. In 1666, the Lords Arlington and Ossory brought it into fashion among people of quality. But it was used in coffee-houses before; for an act of parliament, in 1660, laid a duty of 8d. on every gallon of the infusion sold in these places. In 1666 it was sold in London for 60s. per pound, which cost from 2s. 6d. to 3s. 6d. at Batavia. It continued at this price till 1707. In 1715 green tea began to be used; and as great quantities were then imported, the price was lessened, and the practice of drinking tea descended to the lower ranks. In 1720 the French began to send it to us by a clandestine commerce. Since that period the demand has been increasing yearly, and it has become almost a necessary of life in several parts of Europe, and among the lowest as well as the highest ranks.

Besides immense quantities imported into Britain and Ireland, much has been brought to Europe by other nations. In 1796 the whole tea imported into Europe from China amounted to twenty millions of pounds; in 1815 it was computed to be about 285 millions of pounds.

The finest tea-plant known in England was raised in Kew Gardens; it was carried thither by Sir J. Ellis, who brought it from seed: but the first that ever flourished in Europe belonged to the Duke of Northumberland at Sion, from a drawing of which the accompanying engraving is copied. The plants cultivated in the gardens near London, thrive well in the green-house during winter, and some stand that season in the open air. France has also procured some plants, and no doubt they would succeed in many countries of Europe, if proper care were paid to their cultivation till they became inured to one climate.

CACAO.

This tree being indigenous to America, cacao soon became one of the principal aliments of the Spaniards, as it had from time immemorial been that of the Indians. To the latter it also answered the purposes of money, one hundred and fifty cacao-nuts being valued at a real of eight to the dollar. The relish for chocolate passed after the conquest into Spain, where in a little while it was used as generally as in America. It may even be said to have become, with the Spaniards, a want which precedes that of bread. It was then introduced by the Spanish monks into France.*

As soon as a plantation is cleared, it is crossed with small ditches, in directions according to the declivity of the soil: these serve to drain the stagnant waters, to carry off the rains, and to irrigate or water the soil whenever necessary. The line is then laid out in which the cacao-trees are to be arranged. They are planted in triangles or squares. In either case, there is always in the centre an alley, bordered by cacao-trees, and running from east to west. When they are planted in squares, this alley is crossed by another running from north to south. The cacao-plants should be placed at sixteen feet from each other, in good soil, and about fourteen feet in soil of inferior quality.

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* Chocolate made from cacao is at present used throughout Europe. Each nation gives it a particular preparation, which, however, can differ only in the degree of thickness or liquidity which they allow it, or in the quantity of sugar and the quality of the aromatics which they use in its composition. It is remarked also, that the southern nations prefer the oily cacao, whereas those of the north give preference to the dry and bitter.

This is almost the only tree in nature to which the enlivening beams of the sun are obnoxious. It requires to be sheltered from their ardour; and the mode of combining this protection with the principles of fertility, forms a very essential part of the talents which its cultivation demands. The cacao-tree is mingled with other trees, which guard it from the rays of the sun, without depriving it of the benefit of their heat. The erytrine and the banana are employed for this purpose. The latter, by the rapidity of its growth, and the magnitude of its leaves, protect it for the first year. The erytrine endures at least as long as the cacao: it is not every soil, however, that agrees with it. It perishes after a while in sandy, in clayey soils; but it flourishes in such as combine those two species.

In one range of cacao-trees a banana is placed between two cacaos, an erytrine between the two following. In the other range, a banana is placed between each cacao-tree, and no erytrines; so that the latter are at a distance of two alleys. The banana and the erytrine are first planted, and when a shelter from the sun is thus provided, the hole for the cacao is made, around which are planted four stalks of the yucca plant, at the distance of two feet from each other. At the end of two months the cacao is planted. Until the cacao-plant attains four feet in height, it is trimmed to the stem. If it shoots forth several branches, they are reduced to three, at equal distances; and, in proportion as the plant increases, the leaves which appear on the three branches are stripped off. If they bend much, and incline towards the earth, they are tied in bunches, so that the tree may not remain crooked. The branches, which are trimmed, are cut at the distance of two fingers from the tree. The suckers which spring from the tree are also removed, as they only live at its expense.

The cacao gives two principal crops in a year; one about St. John's Day, the other towards the end of December. The cacao also ripens and is gathered during the whole year. But in all seasons, the people of Tierra Firme make it a point, as far as possible, to collect their crops only at the decline of the moon, because, say they, experience proves that this precaution renders the cacao more solid, and less liable to spoil.

To collect the cacao, those negroes and Indians are employed who have the sharpest sight, that only the ripe fruit may be gathered. The most robust and active are chosen to carry it to the places where the grain is to be shaken out. The aged and maimed are employed to shake out the grain. This operation is performed on a place well swept, and covered with green leaves, on which they place the cacao. Some open the pod, and others strike out the grain with a small piece of wood, which must not be sharp, lest it should injure the grain.

The good and bad cacao must not be mingled together. There are four sorts of cacao in every crop; the ripe and in good condition, the green but sound, the worm-eaten, and the rotten. The first quality is best.

The cacao must always be exposed to the sun on the fourth day after it has been gathered, and this exposure should be daily repeated until it is perfectly dry. When that is the case, the grains burst on being squeezed, their shell resounds when struck, and they no longer become heated on being placed in heaps: the latter is the best proof that the moisture injurious to their preservation is dissipated. If the cacao is not sufficiently exposed to the sun, it becomes mouldy; if too much, it withers and easily pulverizes; in either case it soon rots.

The cacao plant is not in a state of perfect produce till the eighth year in the interior, and the ninth in plantations on the coast. The cacao-tree continues productive to the age of fifty years on the coast, and thirty years in the interior country.

The cacao harvest is extremely variable. The tree vegetates with such strength, that flowers spring out even from the ligneous roots, wherever the earth leaves them uncovered. It suffers from the north-east winds, even when these winds lower the temperature only a few degrees. The heavy showers that fall irregularly after the rainy season during the winter months, from December to March, are also very hurtful to the cacao-tree; and the proprietor of a plantation of fifty thousand trees often loses the value of more than four or five thousand piastres in cacao in one hour.

VANILLA is produced from a creeping plant, which, like the vine, entwines round the trees. It grows in great plenty in the forests of San Philip and Truxillo, on the banks of the Tuy. It requires uncultivated and moist grounds, which are covered with large trees.

To multiply the number of this valuable plant, nothing more is necessary than to insert some cuttings in the earth near a tree: they soon take root, and entwine about it with a firm hold. A surer but less convenient method to prevent the decay of the plant, is to graft the cuttings in the tree itself, about twenty inches above the ground.

The COCOA-TREE, in America, is in general cultivated around farm-houses to be eaten as fruit. In the Gulf of Cariaco it forms real plantations. In a fertile and moist ground, the cocoa-tree begins to bear fruit in abundance the fourth year; but in dry soils it yields produce at the end of ten years only. The duration of the tree does not in general exceed eighty or a hundred years; and its mean height at this period is from seventy to eighty feet. This rapid growth is so much the more remarkable, as other palm-trees, for instance, the moriche, and the palm of Sombrero, the longevity of which is very great, frequently do not reach above fourteen or eighteen feet in sixty years.

In the first thirty or forty years, a cocoa-tree bears every month a cluster of ten or fourteen nuts, all of which, however, do not ripen. It may be reckoned, that on an average a tree produces annually a hundred nuts, which yield eight flasks of oil. The cocoa-tree bears fruit in abundance till it is thirty or forty years old; after this age the produce diminishes, and a trunk a hundred years old, without being altogether barren, yields very little produce.

THE COCOA-NUT TREE.

THE fruit is called by the Portuguese *coco* and *coquen*, from the three holes at the end of the shell, which give it the appearance of a monkey's head. It grows in a stately column, from thirty to fifty feet in height, crowned by waving branches, covered with long spiral leaves; under this foliage, bunches of blossoms, clusters of green fruit, and others arrived at maturity, appear in mingled beauty. The trunk, though porous, furnishes beams and rafters for habitations; and the leaves, when platted together, make an excellent thatch, and common umbrellas, coarse mats for the floor, and brooms; while their finest fibres are woven into beautiful mats for the rich. The covering of the young fruit is extremely curious, resembling a piece of thick cloth, in a conical form, close and firm as if it came from the loom; it expands after the fruit has burst through its inclosure, and then appears of a coarser texture. The nuts contain a delicious milk, and a kernel sweet as the almond: this, when dried, affords abundance of oil; and when that is expressed, the residue feeds cattle and poultry, and makes a good manure. The shell of the nut furnishes cups, ladles, and other domestic utensils, while the husk which encloses it is of the utmost importance; it is manufactured into ropes, and cordage of every kind, from the smallest twine to the largest cable, which are far more durable than those of hemp. In the Nicobar islands, the natives build their vessels, make the sails and cordage, supply them with provisions and necessaries, and provide a cargo of arrack, vinegar, oil, jaggree or coarse sugar, cocoa-nuts, coir, cordage, black paint, and several inferior articles, for foreign markets, entirely from this tree.

Many of the trees are not permitted to bear fruit; but the embryo bud, from which the blossoms and nuts would spring, is tied up to prevent its expansion; and a small incision being then made at the end, there oozes in gentle drops a cool pleasant liquor, called tarce, or toddy; the palm-wine of the poets. This, when first drawn, is cooling and salutary; but, when fermented and distilled, produces an intoxicating spirit. Thus a plantation of cocoa-nut trees yields the proprietor a considerable profit, and generally forms part of the government revenue.

The cocoa-nut tree delights in a flat sandy soil, near the sea, and must be frequently watered; while the palmyras, or brab-trees grow on hills, and rocky mountains. These also abound in the Maldives, as well as the date-tree; but the fruit of the latter seldom attains perfection. These trees are of the same genus, though differing according to their respective classes; they all produce the palm-wine, and are generally included under the name of palms, or palmettos.

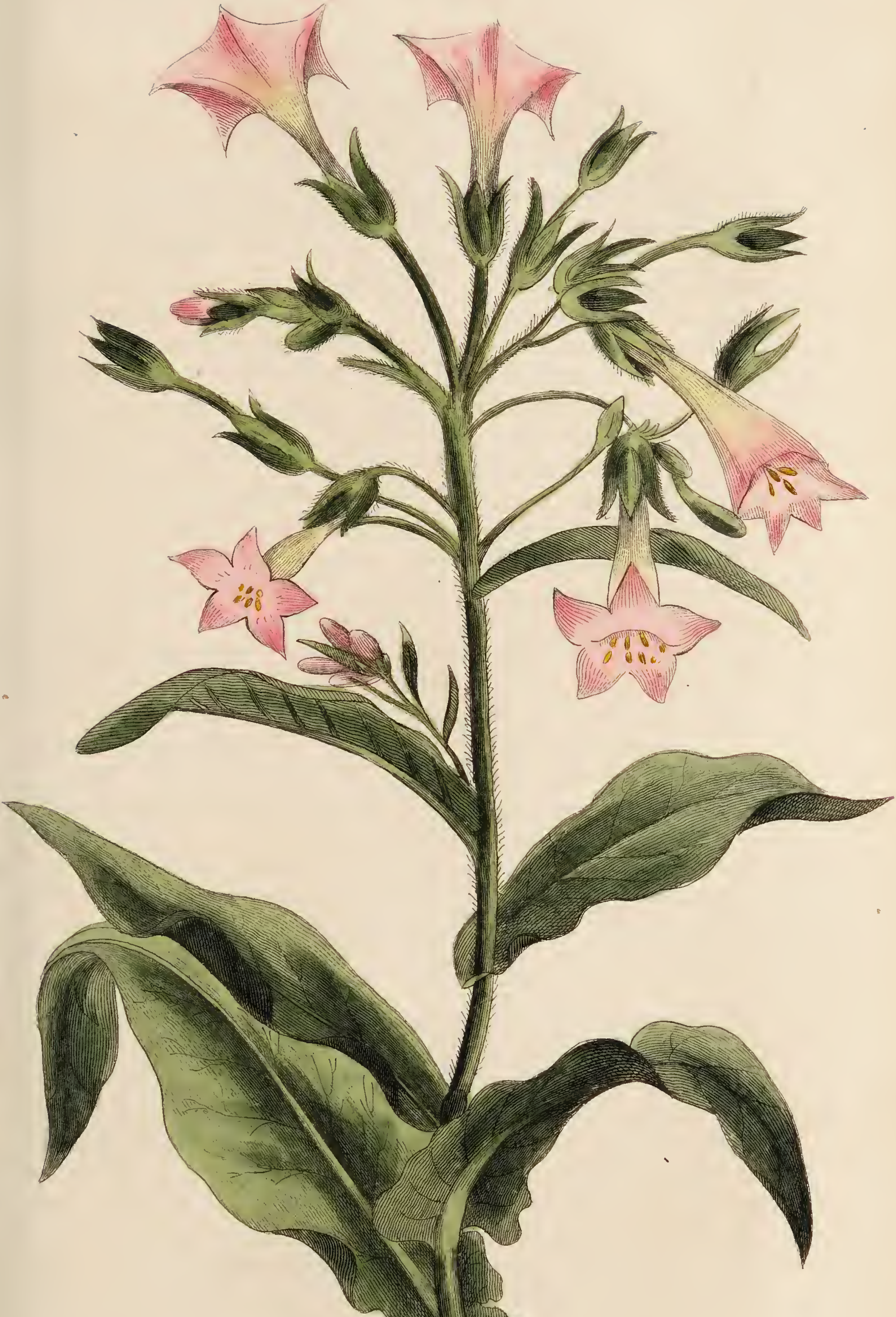
It is found in a wild state in the Maldives and Ladrones, &c. as also in the islands of the South Seas.—The roots are very slender, simple, and flexile; they arise separately from the bottom of the trunk, and spread in all directions; some running to a great depth, while others creep almost parallel to the surface. The trees grow to a great height; their stems are composed of strong fibres, like net-work, which lie in several laminæ over each other, out of which come the branches, or rather leaves, which grow twelve or fourteen feet long. The flowers come out round the top of the trunk of the tree in large clusters; they are inclosed in a large spathe or sheath, and the nuts afterwards are formed in large clusters, ten or twelve together. The fruit is very large, rounded-three-cornered, tawny or reddish, becoming finally of a very pale red or brownish colour; the skin is thin and very tough, the substance under this investing the shell is extremely fibrous. The shell itself is of a bony substance, three-sided, marked with three raised spurious sutures, and having three holes at the base closed with a black membrane; it is one-celled, valveless, and of a dark-brown colour.—The kernel adheres all round the inner wall of the shell, and the cavity is filled with a milky liquor. The kernel in some nuts is near an inch thick, and the hollow contains about a pint of a sweet, delicate, wholesome, refreshing liquor.

While the nut is growing, all the inside is full of the liquor; but, as the nut grows towards maturity, the kernel begins to settle round the inside of the shell, and is soft like cream; as the nut ripens, it increases in substance, and becomes hard. The ripe kernel is sweet, but very hard to digest, therefore seldom eaten, unless by strangers; but while it is young and soft, like pap, some will eat it, scraping it out with a spoon, after they have drank the liquor. The liquor is very pleasant while the nuts are young; but as they grow old it becomes more sharp and cooling. The kernel is very nourishing, much used in making soups, curries, &c., and may be substituted for almonds, in emulsions and apozems, where it can be had fresh. A pure sweet oil is extracted from it, fit both for the table and medicinal uses; in the Society Isles they scent it with santal-wood and other perfumes, in order to anoint their hair and skin with it.

TOBACCO.

The most remarkable species of this plant is the *tabacum*, or common tobacco-plant, first discovered in America, by the Spaniards, in 1560, and by them imported into Europe. It had been used by the Americans long before; and called by the inhabitants of the islands yoli, and petun by those of the continent. It was sent into Spain from Tabaco, in Yucatan, where it was first discovered, and whence its common name. Sir Walter Raleigh is said to have first introduced it into England, about 1585, and taught his countrymen to smoke it. Dr. Cotton Mather, however, (in his Christian Philosopher) says, in that year one Mr. Lane carried over some from Virginia, which was the first seen in Europe. Tobacco is commonly used among the oriental nations, though it is uncertain who introduced it among them. Considerable quantities are cultivated in the Levant, on the coasts of Greece and the Archipelago, in Italy, and Malta.

The two varieties cultivated for common use are distinguished by the names of Oronokoo, and sweet-scented tobacco; the leaves of the former being longer and narrower than the latter. They are tall herbaceous plants, growing erect with fine foliage, and rising with a strong stem six to nine feet high. The stalk, near the root, is upwards of an inch in diameter, and surrounded with a yellowish green, hairy or velvet clammy substance. The leaves are of a deeper green, and grow alternately at two or three inches distance. They are oblong, spear-shaped, oval, and simple; the largest about twenty inches long, but decreasing as they ascend, till they come to be only ten inches long, and about half as broad. The face of the leaves is much corrugated, like those of spinage when full ripe. Before maturity, when about six inches long, the leaves are generally of a full green, and rather smooth; but as they increase in size, they become rougher, and acquire a yellowish cast. The stem and branches are terminated by large bunches of flowers collected into clusters, of a delicate red; the edges, when full blown, inclining to a pale purple. They continue in succession till the end of summer; when they are succeeded by brown kidney-shaped seeds, very small, each capsule containing about 1000; and the whole produce of a single plant 350,000.—The seed ripen in September.



Nicotiana Tabacum _ Virginian Tobacco.

Neele & Son 352 Strand

London Published by Sir R. Phillips & Co. Feb. 10. 1823.

This plant requires a fat and humid soil. Sand mingled with the mould produces the best tobacco. It would reproduce itself from its seed; but nurseries are established which demand a rich soil where the water does not settle and stagnate; for the seeds would rot instead of sprouting.

The tobacco is planted in lines three feet and a half distant from each other. The holes are made at two feet distant in high ground, and at one and a half in the plains. The plant should be placed in the hole with great precaution. Care should be taken, not only against damaging its tender roots, but also that the soil which clings to them should be detached in taking up.

The plant soon springs up, and forms on the summit a bud, towards which the sap would direct itself if a remedy was not applied. The means employed with success is to cut off the bud. The plant is then one foot and a half in height. The tobacco becomes bushy, and acquires by degrees a colour between blue and green, a sign of its approach to maturity. It is known to be ripe by a small blueish spot which forms itself at the point where the leaf joins to the stem. It highly important to the quality of tobacco, that it should not be gathered except when the sun is in full force above the horizon. As the ripe leaves are gathered they are placed in heaps from twenty to twenty-five, between the ranges of the plants. The labourers collect them, arrange them on mats, cover them to protect them from the sun, and in this manner transport them to the manufactory.

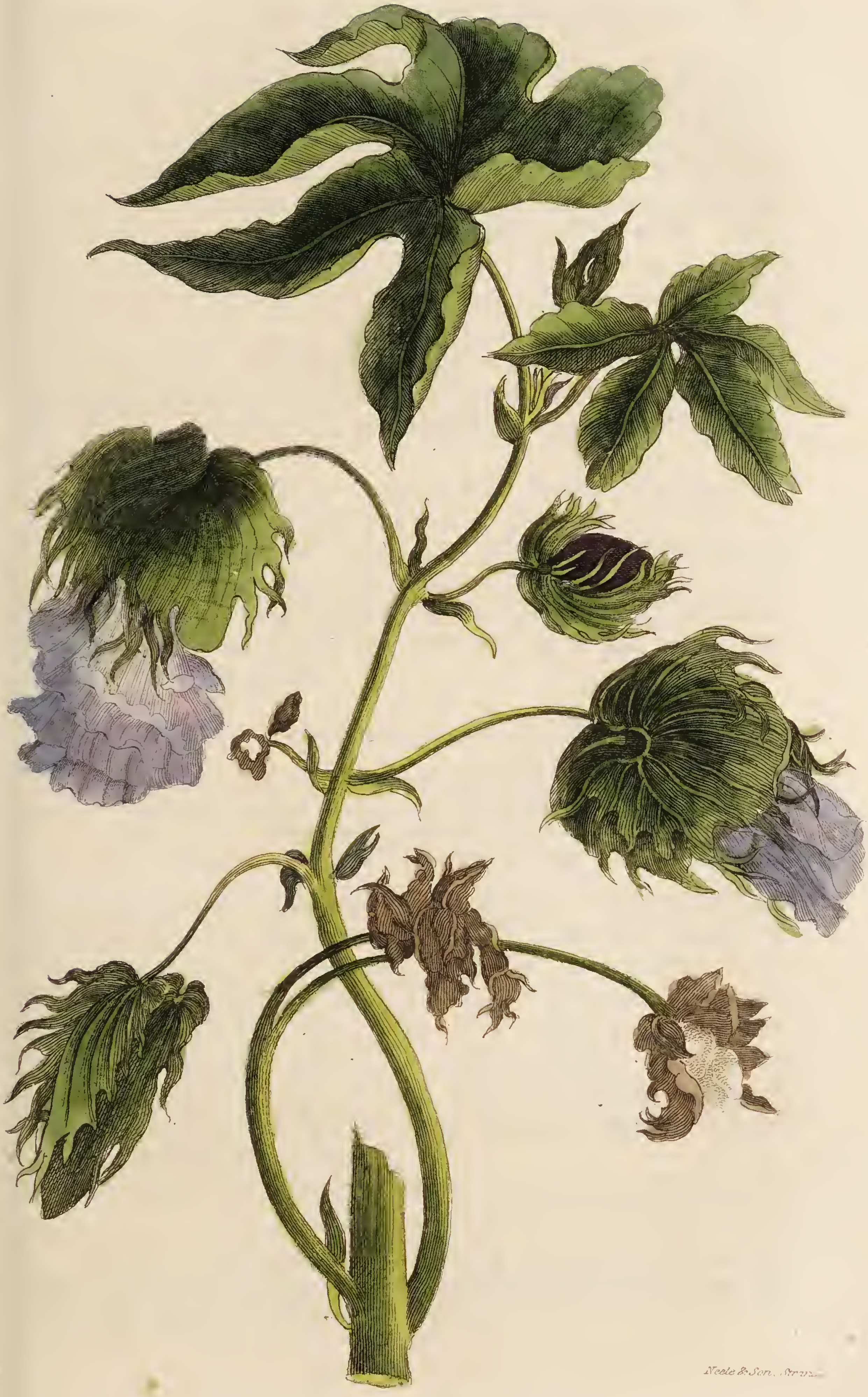
As soon as the tobacco arrives from the fields at the houses assigned for its preparation, it is divided into small parcels, which are placed in the shade until the next day. At the end of twenty-four hours, it is hung under sheds, and on bars, the leaves of tobacco two and two if in winter, or four and four if in summer.—As soon as the tobacco has obtained the due colour and softness, it is taken down, without being piled up, lest it should ferment. The stalk is then taken out from the point until within four inches of the part where the leaf was united to the stem. This is done with the fingers, and with the caution necessary to prevent the leaf from being damaged.

At the same time cords or twists are made of these leaves, which they divide into balls of seventy-five pounds, which, after the process of preparation, diminish into twenty-five pounds. All this requires great celerity, because the leaves may dry, and consequently it would be more difficult to take out the stalk, and to twist them. The interior of the cord is made, like segars, of broken or damaged leaves, which are covered with a good leaf. As soon as the ball is of the proper size, it is made anew, so that the outward end becomes the centre of the new ball. This is done to prevent it from untwisting. The balls of tobacco are then placed on beds or layers of a foot thick, formed of the branches or stalks, covered with the damaged tobacco. A covering of the branches is likewise spread over the balls, and kept down by weights or skins. All this should be done in the shade, and under sheds; for it is necessary to guard against the sun and the rain.

The tobacco is suffered to ferment for forty-eight hours, if it was too dry when the large stalk was taken out; but only twenty hours if it was at its proper point. It is afterwards rolled anew, so that what was on the exterior becomes the centre; and at the same time it is highly moistened to prevent fermentation.—The balls are then returned to their former place, to ferment; and in this state they are left for twenty-four hours, if, the first time, they were suffered to ferment forty-eight, and *vice versa*.

When it is judged that the balls of tobacco have sufficiently fermented, they are exposed to the air until they become cold: they are wound over every morning and evening for three or four days. By this process more or less repeated, the visible defects of the tobacco are corrected. It is entirely exempt from them if its colour is blackish, its juice viscid, and its smell agreeable.

At the end of eight days it is uncovered to inspect the state of the fermentation; if it is too considerable, the manoques are suspended anew in a place sheltered, but airy, where they remain until the fault of excessive fermentation is visibly corrected. If the fermentation is at the point desired, a new heap is formed in an inverted order, and with the same precautions. Fifteen days afterwards the fermentation is examined to invert



Neele & Son. Strand.

COTTON TREE.

London, Published by Sir R. Phillips & C.º Feb. 10. 1823.

the heap once more; it remains in this new state fifteen days, as in the preceding instances.

All the operation being finished, the heap is made anew for the last time. The manoques are detached, the cords of tobacco extended at full length in a magazine slightly watered, the ground of which is covered with fresh banana-leaves, which are likewise sprinkled, or which have been rendered humid by the dew. The first layer of tobacco being made, it is covered with similar leaves, and new layers are successively formed, until the whole of the tobacco is thus heaped up. Then a strong layer of banana-leaves is spread above, which is kept down by weights, and sometimes a little water is added, if there is any apprehension that the tobacco is too dry.

It remains in this situation four days. The manufacturer then untwists the cord, and ascertains the quality of the tobacco. He separates the pieces of an inferior quality, and makes them into balls of twenty-five pounds. The tobacco of the first quality receives the same form; and both the one and the other are placed in magazines.

THE COTTON-TREE, *(Gossypium.)*

So now, where Derwent rolls his dusky floods,*
Through vaulted mountains, and a night of woods,
The nymph of Gossypia, treads the velvet sod,
And warm'd with rosy smiles the watery God. DARWIN.

THERE are several species of this tree. The common Levant cotton, which is cultivated in several islands of the Archipelago, in six months becomes as large as an European quince. The Indians use the leaves for cooling and healing wounds; the tree bears rich sulphur-coloured flowers, very large and beautiful. After the flowers drop, a head of seed follows, which, when it comes to maturity, bursts open, scatters the seeds, and discovers the white cotton.

In China is chiefly cultivated that particular species or variety of the gossypium that produces the cloth usually called nankeens in Europe. The down enveloping the seed constitutes what, in the language of trade, is called cotton-wool, which is of a white colour in the common plant, but in that growing in the province of Kiung-nan, of which the city of Nankin is the capital, the down is of the yellow tinge, which it preserves when spun and woven into cloth. The colour, as well as the superior quality of this substance, in Kiung-nan, was supposed to be owing to the particular nature of the soil.

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* On the river Derwent, near Matlock, Sir Richard Arkwright first erected his curious machinery for spinning cotton, now become the staple of our manufactures.

The Barbadoes Cotton-Tree, with a stem from six to fifteen feet in height, is the species which is so much cultivated in the West Indies, and forms the chief branch of their exports. All the species of gossypium, or cotton, are very tender, and will not grow in the open air in England. It is propagated in the West Indies, by the seed, which is set in rows, about five feet asunder. It grows from four to six feet high, and produces two crops annually; the first, in eight months from the time of sowing the seed; the second, within four months after the first; and the produce of each plant is reckoned about one pound weight. When great part of the pods are expanded, the wool is picked, and afterwards cleared from the seeds by a machine called a gin, composed of two or three smooth wooden rollers, of about one inch diameter, ranged horizontally, close and parallel to each other, in a frame; at each extremity they are toothed or channelled longitudinally, corresponding one with the other; and the central roller, being moved with a treadel or foot-lath, resembling that of a knife-grinder, makes the other two revolve in contrary directions. The cotton is laid, in small quantities at a time, upon these rollers, whilst they are in motion, and, readily passing between them, drops into a sack, placed underneath to receive it, leaving the seeds, which are too large to pass with it, behind. The cotton, thus discharged from the seeds, is afterwards hand-picked, and cleansed thoroughly from any little particles of the pods or other substances which may be adhering to it. It is then stowed in large bags, where it is well trod down, that it may lie close and compact; and the better to answer this purpose, some water is occasionally sprinkled upon the outside of the bag; the marketable weight of which is usually three hundred pounds. An acre may be expected to produce from two hundred and forty pounds to that quantity; or two hundred and seventy pounds on an average.

There is perhaps no plant less delicate than the cotton-tree respecting the nature of soil. It grows on almost all lands; and if any preference be shewn, it is in favour of those grounds which other vegetables reject. It only requires particularly to be protected from the north winds, which are destructive to it, by reason of the drizzling rains which accompany or follow them. Heavy rains are equally injurious. The same degree of humidity which gives vigour to the vegetation of coffee, cacao, and the sugar-cane, occasions the cotton-plant to perish.

Cotton-trees are generally planted in a quincunx form. This mode requires more time and skill, but has advantages which entitle it to a preference. The holes to receive the seed are four feet distant from each other, and in each five or six grains are thrown. When half the number rise, the plantation is fortunate. In fifteen days the young plant begins to shoot: at this period a light rain assists it; but it dees not make very evident progress during the first five or six weeks.

From the fifth to the sixth month, the plant furnishes abundance of flowers, to which succeed the husks or pods containing the seeds, enveloped in a down which is called cotton. After the seventh month the cotton bursts the pod, and if not gathered in time, it falls to the ground and is spoiled. Violent winds and heavy rains, which happen during the cotton harvest, occasion considerable losses to the planter. It is not merely at this epoch that the cotton-plant experiences many risks. Its seed, softened by the developement of the germe, is devoured by worms, wood-lice, and scarabs. In the first month of its existence it is attacked by crickets, who effect their ravages in the night. Its leaves while tender are the pastures of insects called *Diablotins* (little devils.) An infinitude of other worms contribute equally to its loss in the colonies.

As soon as the harvest is finished the cotton-plant is cut; the former merely everv second or third year, the latter every year, and within three or four inches of the ground. The generality are of opinion that in replanting it every year they are ensured a better crop; and, in conformity to this belief, all the planters who have sufficient hands to perform this increase of labour, renew every year their plantations of cotton.

It is not merely in its cultivation that the cotton requires most care; it derives its value chiefly from the manner in which it is prepared. The cleaning or picking is unquestionably the most delicate operation; it is above all essential that the cotton should be freed from the grains which it envelopes in the pod, and that these grains should be removed whole. If broken, they impart yellow stains to the cotton, which diminish its value in proportion to the extent of the damage. The principal merit of cotton consists in its whiteness; and whatever contributes to deprive it of that quality, does it a material injury.

INDIGO.

Indigo is one of those plants which require a light soil and warm climate.* The land destined for it should be well cleared and drained; for the same degree of humidity which favours the nourishment of the plants, is fatal to indigo. In ground on which indigo is to be sown, the wood should be cut four months before it is set on fire. The flames consume it then more readily to the stumps. The lines or rows are then to be immediately traced, and the earth being thus well cleared, the seeds are to be sown under favour of the first rain, and three months suffice to produce a good crop.

After three months, the indigo is commonly fit to cut, and this operation is far from immaterial. It has also its rules and its procedure. The first object of attention is the maturity of the indigo; the second, to cut the plant one inch from the earth. To cut it higher may retard the shoots of a second cutting, or may even entirely prevent them. Large crooked knives are much more convenient for this purpose than any other instrument; and at the same time more advantageous with regard to the subsequent crops. The indigo plant is transferred as soon as cut to the place where art must give it the form under which it becomes merchandise.

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* The indigo found in commerce, is produced by four species of plants: the indigo fera tinctoria, i. anil, i. argentea, and i. dispesma. At the Rio Negro, near the frontiers of Brazil, the i. argentea is found growing wild, but only in places anciently inhabited by Indians.

The manufactories, says Humboldt, which we examined, are all built on the same principles. Two steeping vessels or vats, which receive the plants intended to be brought into a state of fermentation, are joined together. Each of them is fifteen feet square, and two and a half deep. From these upper vats the liquor runs into beaters, between which is placed the water-mill. The axle-tree of the great wheel crosses the two beaters. It is furnished with ladles fixed to long handles, adapted for the beating.

The blue colouring substance, known to us under the name of indigo, is combined with heterogeneous articles, from which the manufacturer must disengage it.—This combination is so intimate, that it eludes the nicest eye. Like many other results, it appears to be the product of a peculiar operation, the effect of which gives great satisfaction. In proportion as heat increases, azote is disengaged, the herbaceous mucilage separates, the vegetable is decomposed, the mixture absorbs oxygen. At first the liquor takes in the basin a green tinge. It is strongly agitated, that the elements of the vegetable may subtilize, and the fermentation speedily augments to the highest degree. The fermenting fluid passes from a green to a violet tinge, and this by degrees changes to a blue colour.

It is only requisite to write on white paper with the matter to be examined. If this ink be of very high colour, it is a proof that the fermentation is not yet at its true point. The experiment is repeated every quarter of an hour, till it is perceived that the liquid has lost its colour. This was pronounced an infallible index to shew the true point of fermentation. After signs of complete fermentation are obtained, the whole contents of the first cuve are passed into the second, where it undergoes another process still more important, as it is intended to separate the carbonic acid, and to facilitate the reunion of the particles composing the blue feculæ or sediment. This object is obtained by violently agitating the fluid. No less care, attention, and experience, are requisite in this than in the preceding operation. According as it is well or ill performed, it may correct the errors of imperfect fermentation, or may occasion the loss of indigo, which has thus far been correctly fabricated. If it be not sufficiently beaten, the grain is left diffused in the water, without reuniting at the bottom of the cuve: the mass of feculent matter that forms the indigo is also diminished. If it be beaten too much, the grain is dissolved and broken.

It only remains to put the indigo into sacks, which should be suspended to facilitate the expression of the water it still retains. It is then put to dry in the sun, in boxes made for the purpose, or on planks of brasiletto, which, having small wheels, can be sheltered under a roof in case of sudden rains. These sloping and very low roofs give the drying-place the appearance of a hot-house at some distance. Before it is perfectly dry, it is cut in small pieces, of an inch square, which detach themselves readily from the box when the indigo is entirely dry.

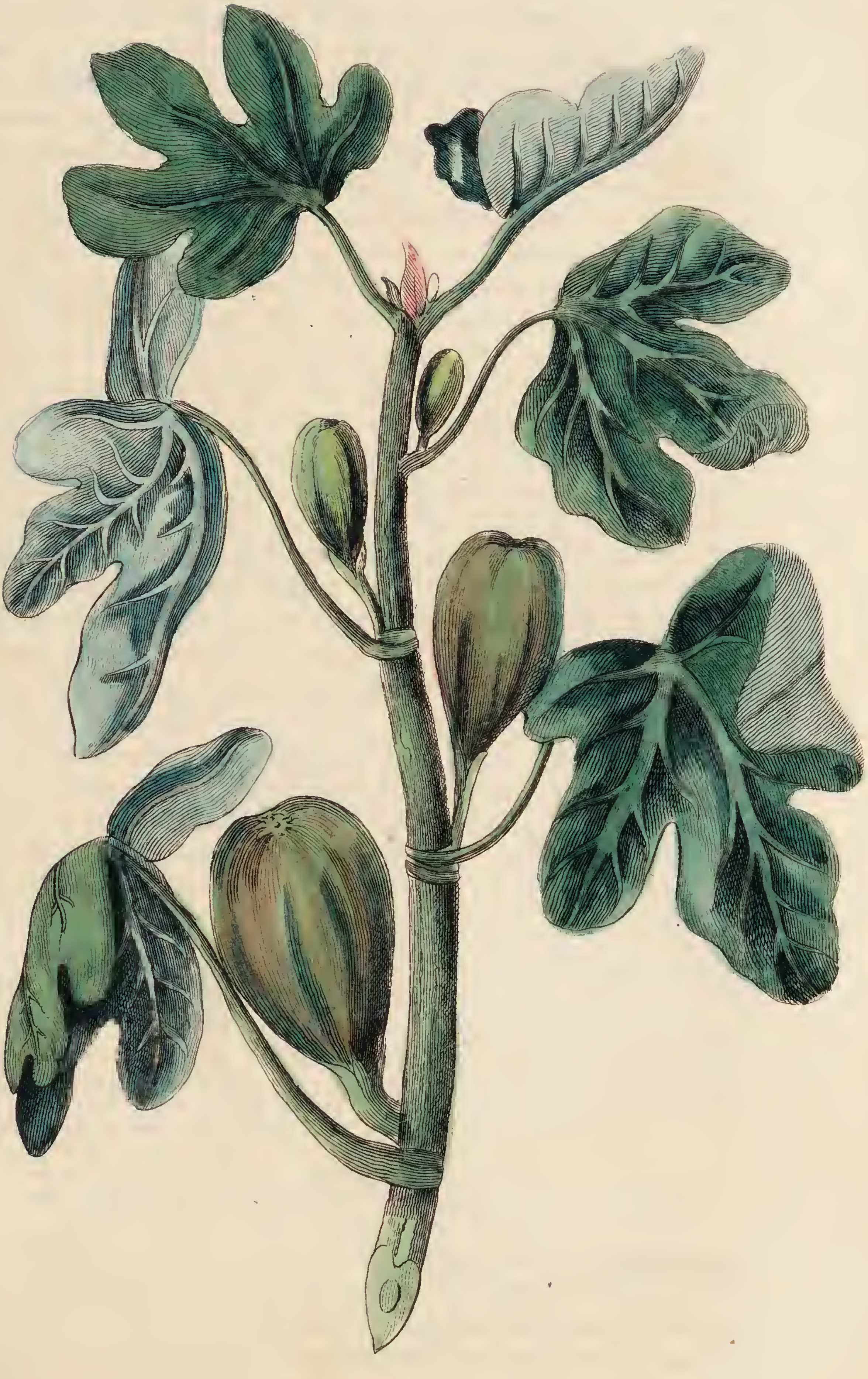
It is customary to pack the indigo in barrels, and thus to circulate it in commerce. The Spaniards alone put it in packages of a hundred pounds, and so well conditioned, that the rough usage they encounter between the place of manufacture and the sea-port does not occasion any damage.

LECTURE LXXVII.

TROPICAL TREES AND PLANTS, (*Continued.*)

THE FIG-TREE, (*Ficus.*)

Is a native of Asia, though it was introduced into Greece and Italy in very early ages. It seldom exceeds two yards in height; and the trunk is about the thickness of the human arm. The first fig-trees introduced into England are still remaining in the archbishop's



Ficus Carica _ Common Fig Tree.

London, Published by Sir R. Phillips & Co. Feb. 10. 1823.

garden at Lambeth. They are of the white Marseilles kind, and still bear delicious fruit. They cover a surface fifty feet in height, and forty in breadth. The circumference of the trunk of the southernmost is twenty-eight inches, of the other twenty-one. Tradition says, they were planted by Cardinal Pole, in the reign of Henry VIII. At Mitcham, in the garden of the manor-house, is likewise the white sort, and is asserted to have been planted by Cranmer. Its branches are very low, but its stem measures thirty inches in girth.

In the dean's garden at Winchester, there was, in the year 1757, a very ancient fig-tree, whose fruit was of the small red sort. On the stone-wall to which the tree was nailed there was a plastering, and several inscriptions, one of which mentioned, that in the year 1623 King James I. "tasted of the fruit of this tree with great pleasure." At Oxford, in the garden of the regius professor of Hebrew, is a fig-tree planted by Dr. Pocock, in the year 1648. It bears the marks of great age; and the trunk is perforated by insects, and damaged by time and weather; but the branches of the new wood are clean, make vigorous shoots, and produce a number of small figs; there are many varieties in the warm countries. In England, we had not more than four or five sorts till within a few years past.

The Egyptian or Pharaoh's fig-tree, or sycamore, is a large tree, with leaves like those of the mulberry.—The stem is often fifty feet thick; and, as it spreads out its boughs very much, it is of great use, in a scorching climate, to shade those who travel through the deserts. The mummies in Egypt are preserved in coffins of this wood, which is of a reddish colour, light, and very proper for this use, because it does not rot for many ages. The fruit is produced from the trunk and larger branches, and is shaped like the common fig.

> Arm'd with her ivory beak, and talon hands,
> Descending Fica dives into the sands. DARWIN.

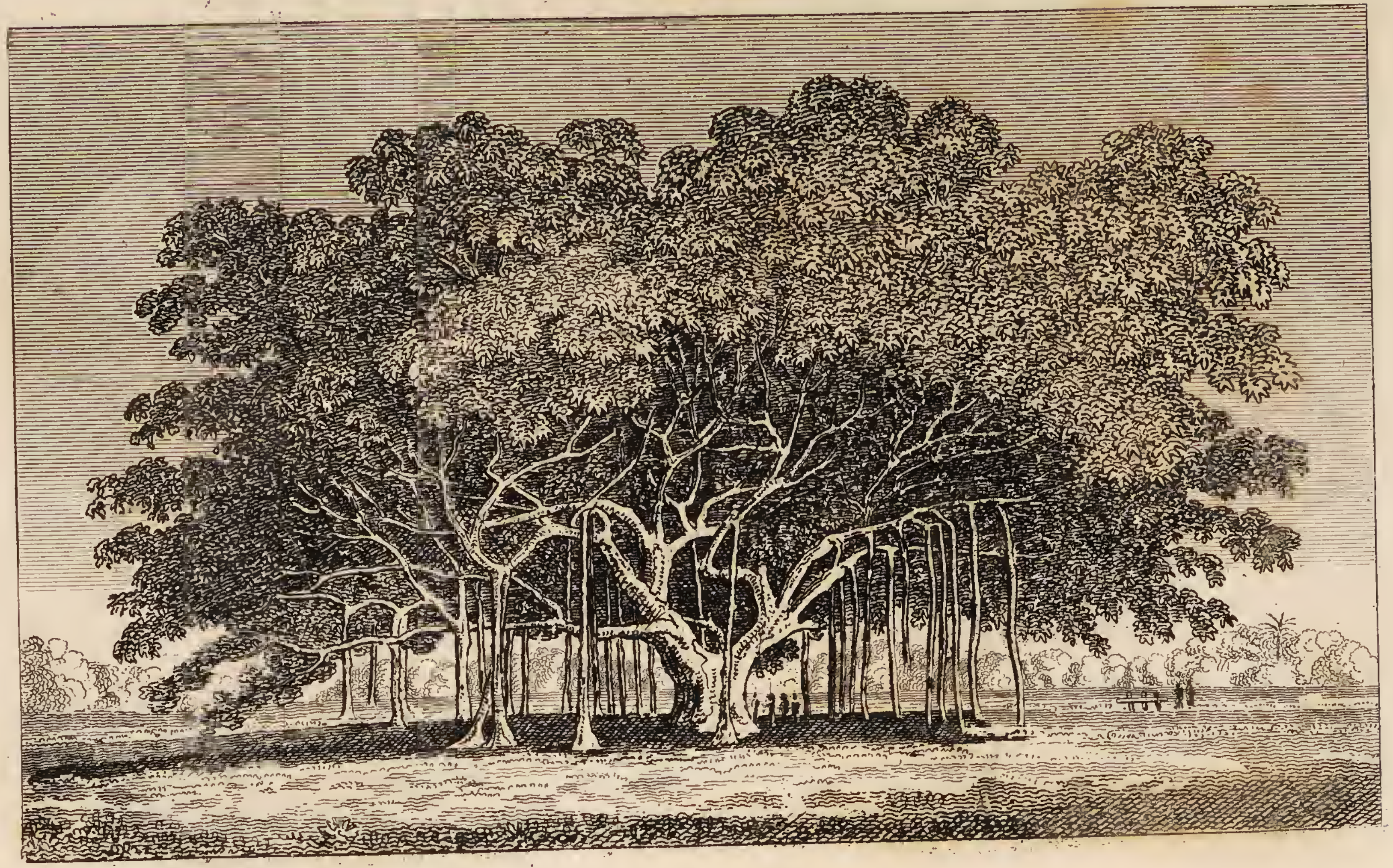
THE Banian or Burr-Tree, the *ficus Indica* of Linnæus, is considered as one of the most curious and beautiful of nature's productions in the genial climate of India, where she sports with the greatest profusion and variety. Each tree is in itself a grove, and some of them are of an amazing size, as they are continually increasing, and, contrary to most other animal and vegetable productions, seem to be exempted from decay: for every branch from the main body throws out its own roots, at first in small tender fibres, several yards from the ground, which continually grow thicker; until, by a gradual descent, they reach its surface; where, striking in, they increase to a large trunk, and become a parent tree, throwing out new branches from the top. These in time suspend their roots, and, receiving nourishment from the earth, swell into trunks, and shoot forth other branches; thus continuing in a state of progression so long as the first parent of them all supplies her sustenance.

A banian-tree, with many trunks, forms the most beautiful walks, vistas, and cool recesses, that can be imagined. The leaves are large, soft, and of a lively green; the fruit is a small fig, when ripe of a bright scarlet; affording sustenance to monkeys, squirrels, peacocks, and birds of various kinds, which dwell among the branches. (See the ENGRAVING.)

The Hindoos are peculiarly fond of this tree: they consider its long duration, its out-stretching arms, and overshadowing beneficence, as emblems of the Deity, and almost pay it divine honours. The Brahmins, who thus "find a fane in every sacred grove," spend much of their time in religious solitude, under the shade of the banian-tree; they plant it near the dewals, or Hindoo temples, improperly called pagodas; and in those villages where there is not any structure for public worship, they place an image under one of these trees, and there perform a morning and evening sacrifice.

These are the trees under which a sect of naked philosophers, called Gymnosophists, assembled in Arrian's days; and this historian of ancient Greece, (observes Forbes, in his Oriental Memoirs,) affords a true picture of the modern Hindoos. "In winter the Gymnosophists enjoy the benefit of the sun's rays in the open air; and in summer, when the heat becomes excessive, they pass their time in cool and moist places, under large trees; which, according to the accounts of Nearchus, cover a circumference of five acres, and extend their branches so far that ten thousand men may easily find shelter under them."

One of these growing near Mangee, twenty miles west of Patna, in Bengal, was in diameter 370 feet: the circumference of the shadow at noon was 1116 feet; the circumference of the several stems, which were fifty or sixty in number, 921 feet. Four miles distant from Fort St. David, in the Carnatic, stands an enormous Ficus Indica, or Banyan-tree, computed to cover near 1700 square yards, under the shade of which 10,000 men might



The Banian Tree in INDIA.

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stand without incommoding themselves; and several people have built houses under the arches, formed by the branches bending down, which taking root become another tree united to the first; the arches which these different stocks make are Gothic. The Gentoos are sensibly hurt if any one cuts or lops off any of the branches. Hence another species is named by Linnæus *religiosa*, being sacred to the god Vistnu, who is said to have been born under one.—Strabo mentions this tree, and says that the branches grow horizontally about twelve cubits, then taking a direction to the earth, where they root themselves, and when they have attained maturity, continue to propagate in the same manner, till the whole becomes like a tent, supported by many columns.

On the banks of the Narbudda, in the province of Guzzerat, is a banian-tree, supposed by some persons to be the one described by Nearchus, and certainly not inferior to it. It is distinguished by the name of the *Cubbeer-Burr*, which was given to it in honour of a famous saint. High floods have, at various times, swept away a considerable part of this extraordinary tree; but what still remains is nearly two thousand feet in circumference, measured round the principal stems; the over-hanging branches, not yet struck down, cover a much larger space; and under it grow a number of custard-apple, and other fruit-trees. The large trunks of this single tree amount to three hundred and fifty, and the smaller ones exceed three thousand: each of these is constantly sending forth branches and hanging roots, to form other trunks, and become the parents of a future progeny.

The CUBBEER-BURR is famed throughout Hindostan, not only on account of its great extent, but also of its surpassing beauty. The Indian armies generally encamp around it; and, at stated seasons, solemn jatarras, or Hindoo festivals, to which thousands of votaries repair from every part of the Mogul empire, are there celebrated. It is said that 7000 persons find ample room to repose under its shade. It has long been the custom of the British residents in India, on their hunting and shooting parties, to form extensive encampments, and spend weeks together, under this magnificent pavilion, which affords a shelter to all travellers, particularly to the religious tribes of the Hindoos. It is generally filled with a variety of birds, snakes, and monkies, the latter of whom both divert the spectator by their antic tricks, and interest him by the parental affection they display to their young offspring, in teaching them to select their food, to exert themselves in jumping from bough to bough, and in taking, as they acquire strength, still more extensive leaps from tree to tree. In these efforts, they encourage them by caresses, when timorous, and menace, and even beat them, when refractory.

Among the varieties of the Banian, or Burr-trees, is the PEIPAL, or *ficus religiosa*, which is not uncommon in Guzzerat, and causes a singular variety of vegetation. It may be considered as belonging to the order of creepers, and often springs round different trees, particularly the palmyra, or palm. The latter, growing through the centre of a banian tree, looks extremely grand. The peipal frequently shoots from old walls, and runs along them, so as to cause a singular phenomenon of vegetation. In the province of Bahar, one of these trees was seen by an English traveller, on the inside of a large brick well, the whole circumference of the internal space of which it lined, and thus actually became a tree turned inside out. A banian-tree thus inserted is uncommon; but the general usefulness and beauty of this variety, especially in overshadowing the public wells and village markets, can only be known by those who live in a sultry climate.

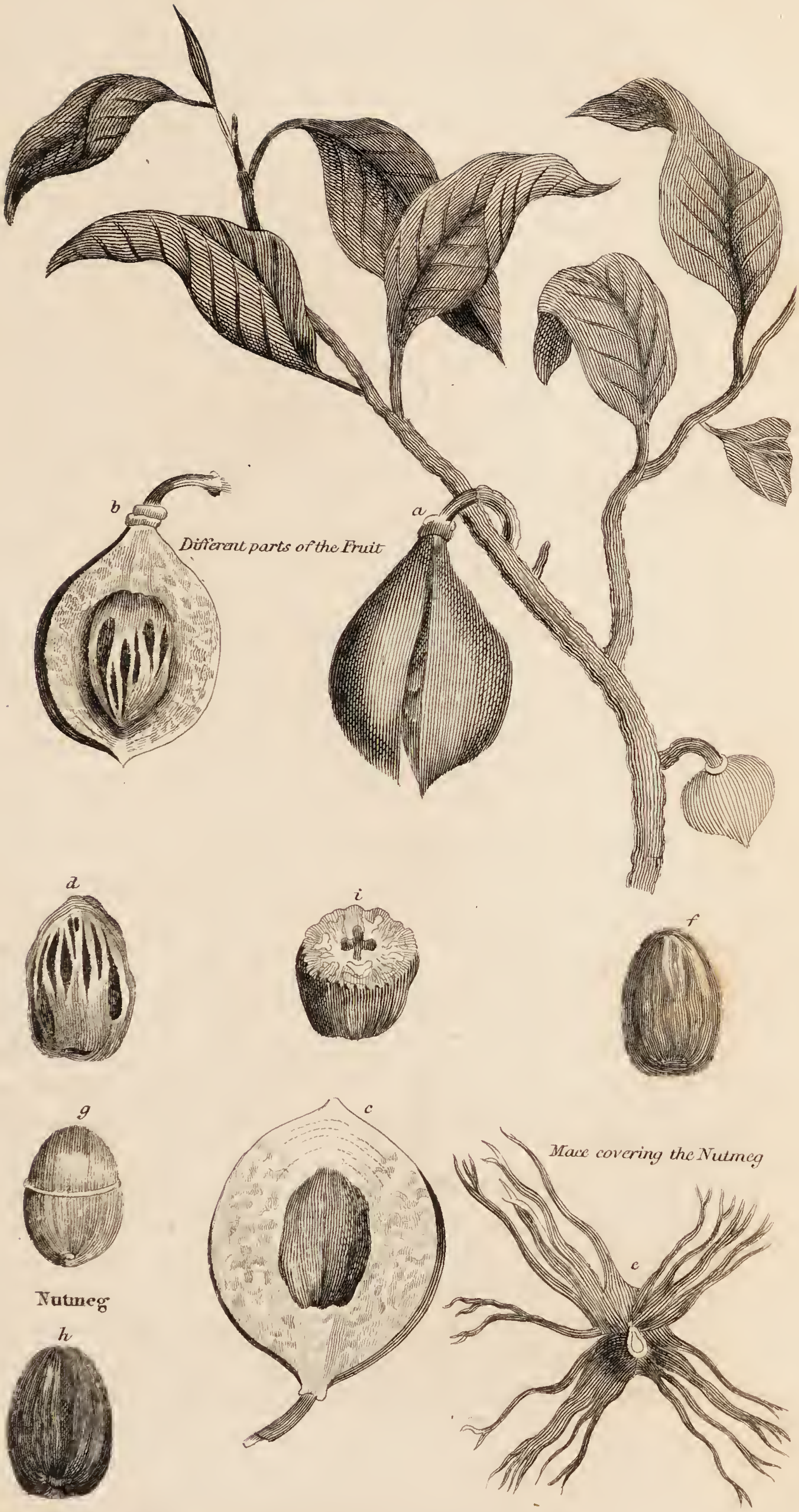
Fig-trees thrive in all soils, and in every situation; but they produce a greater quantity of fruit upon a strong loamy soil.—They are always planted as standards in all warm countries, but in England they are generally planted against walls. One of the Greek fig-trees usually produces between two and three hundred pounds of figs, and those in Provence seldom above twenty-five

THE NUTMEG-TREE, *(Myristica.)*

THE aromatic, or true nutmeg-tree attains the height of thirty feet, producing numerous branches, which rise together in stories, and covered with bark, which of the trunk is a reddish brown, but that of the young branches is of a bright green colour; the inner bark is red: the leaves are nearly elliptical, pointed, undulated, obliquely nerved; on the upper side of a bright green, on the under whitish, and stand alternately upon footstalks; the flowers are small, and hang upon slender peduncles, proceeding from the axillæ of the leaves.

The fruit is a superior berry, elliptic-spheroidal, with a shallow longitudinal groove on one side, fleshy, smooth, and one-celled: the flesh is thick, rather solid, finally drying up into a coriaceous crust, opening on the side.

The nutmeg-tree is a native of the East-Indies, and has in a manner been extirpated in all the islands except Banda, which might easily supply every nation. The Dutch long appropriated to themselves the crop of nutmegs, as well as that of cloves and cinnamon, growing in the islands of Ternate, Ceylon, &c. either by right of conquest or by paying subsidies to the islanders.



Myristica Moschata _ Nutmeg Tree.

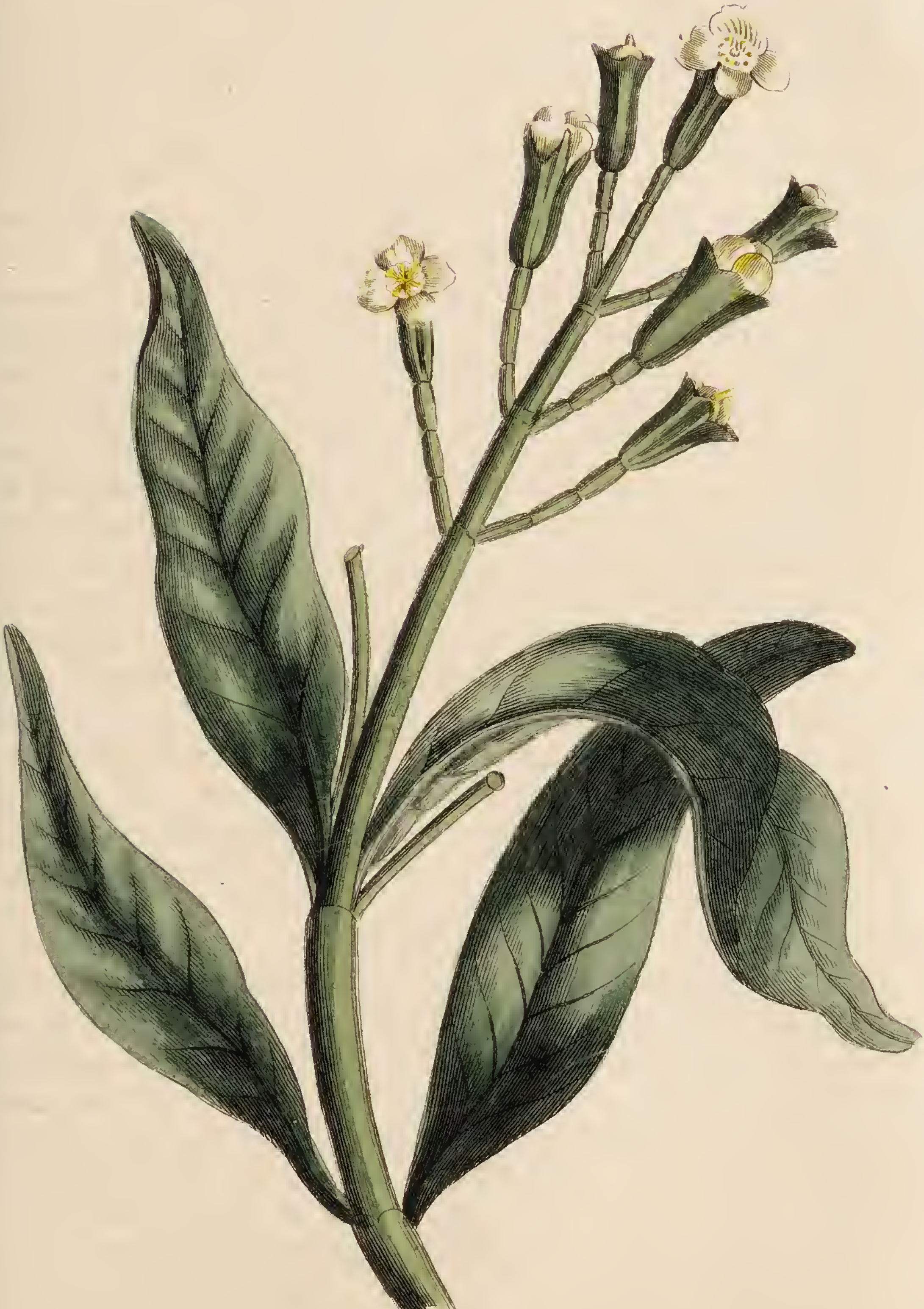
Neele & Son 352 Strand.

The tree is distinguished into three sorts: the male or barren nutmeg; the royal nutmeg, or female producing the long nuts; and the queen-nutmeg, yielding the precious round nuts, intended to reproduce the females, but which gives separately, the one long nuts, intended to give males, the other round nuts intended to produce the two sorts of females; namely, that producing the long, and that producing the round, nut. The only difference between the royal and queen nutmeg is in the fruit. That of the royal is thicker, longer, and more pointed; the green shell is thicker, and it is longer in ripening; the green shell, after opening, preserves its freshness eight or nine days; the mace is more substantial, and three or four times as long as that of the queen-nutmeg; and its stripes or thongs, of which there are from fifteen to seventeen principal ones, are of a livelier red; they are also broader, longer, and thicker, and not only embrace the nut throughout its whole length, but pass it and cross under it, as if to hinder it from falling. The royal nutmeg is generally from fifteen to sixteen lines long, thick in proportion, and has no longitudinal stripe. It remains on the tree a long time after the opening of the green shell, and gives birth to insects in the shell that feed upon it. The queen nutmeg produces much smaller nuts, only nine or ten lines long, not so thick by a third, and well marked by a longitudinal groove on one side; they are round, and resemble a small peach: the green shell is not thick: the mace, which is composed of nine or ten principal stripes, grows only half down the nut, leaving it at liberty to escape and plant itself. By thus detaching itself, the nut prevents the insects from destroying it: the green shell also, changing at the end of two or three days, soon falls, and separates from the nut. This green shell, when preserved, has the fine taste of the nut itself.

The nutmeg-tree, with a smooth brown bark, rises perfectly straight. Its strong and numerous branches proceed regularly in an oblique direction upwards. They bear large oval leaves, pendulous from them, some a foot in length; the upper surface smooth, and of a deep agreeable green; the under surface marked with a strong nerve along the middle, from which others proceed obliquely; it is of a uniform bright brown colour, as if strewed all over with a fine brown powder; and the whole leaf is very fragrant.

When the fruit is ripe, the natives ascend the trees and gather it, by pulling the branches to them with long hooks. Some are employed in opening them immediately, and in taking off the green shell or first rind, which is laid together in a heap in the woods, where in time it putrefies. As soon as the putrefaction has taken place, there springs up a kind of mushrooms, called *boleti moschatyni*, of a blackish colour, and much valued by the natives, who consider them as delicate eating. When the nuts are stripped of their first rind, they are carried home, and the mace is carefully taken off with a small knife. The mace, which is of a beautiful red, but afterwards assumes a darkish or reddish colour, is laid to dry in the sun for the space of a day, and then removed to a place less exposed to his rays, where it remains for eight days, that it may soften a little. They afterwards moisten it with sea-water, to prevent it from drying too much, or from losing its oil. They are careful, however, not to employ too much water, lest it should become putrid, and be devoured by worms. It is last of all put into small bags, and squeezed very close.

The nuts, which are still covered with their ligneous shell, are for three days exposed to the sun, and afterwards dried before a fire till they emit a sound when they are shaken; they then beat them with small sticks, in order to remove their shell, which flies off in pieces. These nuts are distributed into three parcels: the first of which contains the largest and most beautiful, which are destined to be brought to Europe; the second contains such as are reserved for the use of the inhabitants; and the third contains the smallest, which are damaged or unripe. These are burnt, and part of the rest is employed for procuring oil by pressure. A pound of them commonly gives three ounces of oil, which has the consistence of tallow, and preserves entirely the taste of nutmeg. Both the nut and mace, when distilled, afford an essential, transparent, and volatile, oil, of an excellent flavour. The nutmegs which have been thus selected would soon corrupt if they were not watered, or rather pickled with lime-water, made from calcined shell-fish,



Eugenia Caryophyllata _ Clove Tree.

London. Published by Sir R. Phillips & C^o. Feb. 10. 1823.

Neele & Son 352 Strand

which they dilute with salt-water till it attain the consistence of fluid pap. Into this mixture they plunge the nutmegs, contained in small baskets, two or three times, till they are completely covered over with the liquor. They are afterwards laid in a heap, where they heat, and lose their superfluous moisture by evaporation. When they have sweated sufficiently, they are then properly prepared, and fit for a sea-voyage.

In the island of Banda, the fruit of the nutmeg-tree is preserved entire in the following manner. When it is almost ripe, but previous to its opening, it is boiled in water and pierced with a needle. It is next laid in water to soak for ten days, till it has lost its sour and sharp taste. They then boil it gently in a syrup of sugar, to which, if they wish it to be hard, a little lime is added. This operation is repeated for eight days, and each time the syrup is renewed. The fruit, when thus preserved, is put for the last time into a thick syrup, and is kept in earthen-pots closely shut. These nuts are likewise pickled with brine or with vinegar; and, when they intend to eat them, they first steep them in fresh water, and afterwards boil them in syrup of sugar, &c. Nutmegs preserved entire are presented, in the east, as desserts, and the inhabitants of India sometimes eat them when they drink tea. Some of them use nothing but the pulp; others likewise chew the mace; but they generally throw away the kernel, which is really the nutmeg.

THE CLOVE-TREE.

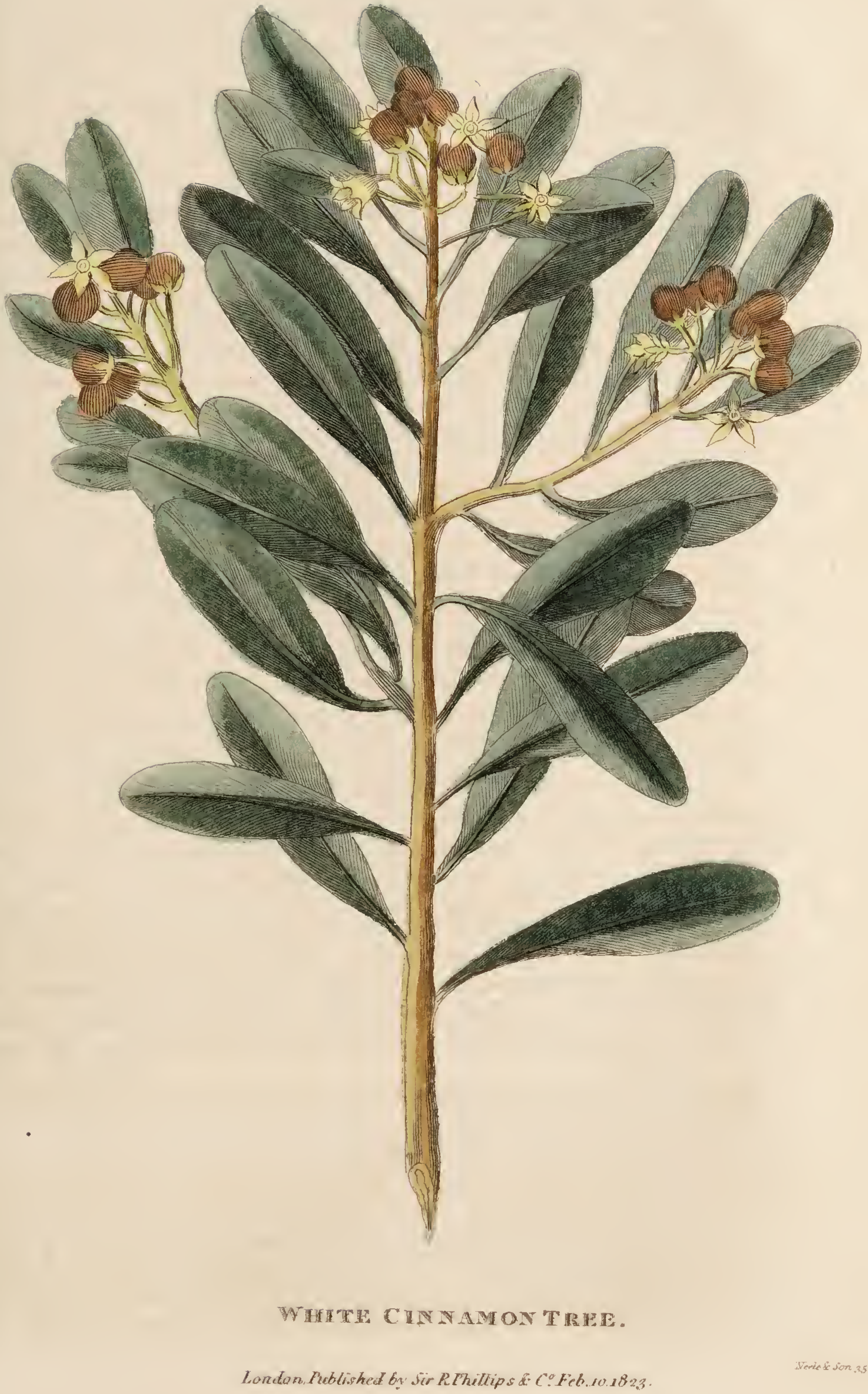
The *caryophyllus aromaticus*, or clove-tree, rises to the height of a common apple-tree, but the trunk generally divides, at about four or five feet from the ground, into three or four large limbs, which grow erect, and are covered with a thin smooth bark, which adheres closely to the wood. These limbs divide into many small branches, which form a sort of conical figure; the leaves are like those of the bay-tree, and are placed opposite on the branches. The flowers are produced in loose bunches at the end of the branches; are small, white, and have a great number of stamens, which are much longer than the petals. The flowers are succeeded by oval berries, which are crowned with the calyx, divided into four parts, and spreading flat on the top of the fruit: the young fruit beaten from the trees before they are half grown, are the cloves used all over Europe.

The clove-shrub is of a pyramidal form; leaves opposite, pointed at each end, smooth, and waving on the edge, on a petiole an inch in length, and red; this petiole is the most aromatic part of the whole shrub, not excepting even the clove. The flowers grow in a *bouquet*, at the ends of the branches; the petals are bluish, veined with white, rounded at the end, and concave; the fruit is reddish, and commonly encloses two seeds. The whole shrub is aromatic, and flourishes in moist situations. It is not confined to Banda and Amboyna, but is found at Ternate, and in all the Moluccas, in many of the South-Sea islands, and New Guinea.

THE BAY TRIBE, *(Laurus.)*

THE Cinnamon-tree, *(laurus cinnamomum,)* is described by Jaquin as growing in America, twenty feet high or more, the trunk is about six feet high, and a foot and a-half in diameter; the outer bark is smoothish, and of a dusky cinereous colour; and it has spreading branches that form an elegant head. The flowers are small, greenish yellow, almost insipid, with a somewhat fetid smell, resembling that of lilium martagon. The fruit, the form and size of a middling olive, is insipid, deep blue, and soft, inclosing a thin pale-coloured nut with a white kernel, which germinates soon after it falls, and therefore cannot easily be transported to a distance. The inner bark resembles the oriental cinnamon in smell, taste, and figure; the only difference is, that it has a coarser texture, and a more acrid taste, which may arise from the climate. But the varieties of cinnamon are numerous. The timber is white and not very solid. The root is thick and branching, and exudes abundance of camphor. It is a native of Martinico, on the mountain Calebasse, and of Brasil.

Albertus Seba gives the following account of the cinnamon of Ceylon. The best sort of cinnamon, which grows in great plenty in Ceylon, and is peculiar to that island, is called by the natives *rasse coronde*, or sharp sweet cinnamon. The second is called *canatte coronde*, or bitter astringent cinnamon. The bark of this comes off very easily, and smells very agreeably when fresh, but has a bitter taste. It has an advantage that it is not so plentiful



WHITE CINNAMON TREE.

London, Published by Sir R. Phillips & C.º Feb. 10. 1823.

Neele & Son 352 Strand

as the first; because it requires much skill and attention to distinguish them. The root of this yields a very good sort of camphor. The third is called *capperoe coronde*, or camphorated cinnamon, because it has a very strong smell and taste of camphor. It grows plentifully in the island, but not in the eastern part. However, they find means to send it over privately, and sell it to the Danes and English trading upon the coast of Coromandel. The fourth sort is called *welle coronde*, or sandy cinnamon, because upon being chewed it feels gritty, or as if grains of sand were between the teeth. The bark comes off easily, but is not so readily rolled up. It is of a sharp bitterish taste, and the roots yield only a small quantity of camphor. The fifth sort is called *sewel coronde*, glutinous or mucilaginous cinnamon. This acquires in drying a considerable degree of hardness; it has little taste, and an ungrateful smell; but the colour is very fine, and the natives mix a good deal of it with the best sort, the colour being much alike, except that in the genuine sort there are some few yellowish spots towards the extremities. The sixth sort is called *nicke coronde*, the tree bearing much resemblance to another tree, which the natives call *nicke gas*. The bark has no taste or smell, and is only used by the natives in medicine. By roasting it an oil is obtained, with which they anoint themselves to keep off infection; and they express a juice from the leaves, with which they rub their heads, to cool and strengthen the brain. The seventh is called *dawel coronde*, or drum-cinnamon; the wood being light and tough, and used by the natives for making drums. The bark is taken off whilst the tree is yet growing; is of a pale colour, and is used for the same purposes as the sixth. The eighth sort is called *catle coronde*, thorny or prickly cinnamon; the tree being very prickly. The bark is in some measure like that of the true cinnamon, but it has nothing of the taste or smell, and the leaves differ very much. The natives apply the root, bark, and leaves, in form of cataplasms to tumours. The ninth sort is called *mael coronde*, or flowering cinnamon, being always in blossom. The flowers come nearest to those of the first sort, but they bear no fruit. The wood never becomes so solid and weighty in this as in the others, which are sometimes eight, nine, or ten feet in circumference. If this tree be cut or bored into, a limpid water will issue from the wound, as from the birch-tree, but it is of no further use than are the leaves and bark. There is a tenth sort, called *toupat coronde*, or three-leaved cinnamon, which does not grow near the Dutch settlements, but higher up towards Candia. Some of these are probably the cassia; and the ninth is the male tree of the true cinnamon.

The use of the cinnamon-tree, however, is not confined to the bark; for it is remarkable that the leaves, fruit, and root, all yield oils of different qualities, and of considerable value. That produced from the leaves is called oil of cloves, and oleum malabathri; that from the fruit is extremely fragrant, and of a thick consistence, and at Ceylon is said to be made into candles, for the sole use of the king; and the bark from the root not only affords an aromatic oil, which has been called oil of camphor, but also a species of camphor which is purer and whiter than the common camphor. The bark of the cinnamon-tree, while on the tree, is first stripped of its outer greenish coat; and is then cut longitudinally from the tree, and dried in the sand, till it becomes fit for the market, when it is of a reddish yellow, or pale rusty-iron colour, very light, thin, and curling up into quills, or flakes.

Linnæus, in his Hortus Cliffortianus (1737), speaks of cinnamon as a forbidden tree, not then known in Europe but from dried specimens, and not easy to be introduced, probably from the jealousy of the Dutch. It was, however, cultivated by Mr. Miller before 1768; and is now cultivated both in our territories in the East Indies and in the islands of the West Indies. Mons. Poivre also introduced it, with the nutmeg and clove, into the isles of France and Bourbon. Dr. George Young had 140 cinnamon-trees, at St. Vincent's, in May, 1772. In 1789 it was successfully cultivated in Jamaica, from trees taken in a French prize by Admiral Rodney, and presented by him to the assembly of that island. In 1792, samples of this cinnamon, sent by Dr. Dancer, were examined by a committee of the Society of Arts, &c. and some eminent dealers in that spice; who were of opinion that two of the samples were excellent, and even preferable to any cinnamon imported from Ceylon, both in colour and flavour. Mrs. Anstey brought two cinnamon-trees from Ceylon to Madras; and Dr. Roxburgh procured six trees in 1789.

The Cassia, or wild Cinnamon-tree, is said to be the same species as the preceding, or true cinnamon. The cassia-bark is coarser, and will not roll up like true cinnamon.

Mr. Marsden says, that the cassina or cassia trees grow from 50 to 60 feet high, with large spreading horizontal branches, nearly reaching the earth. The leaves are about four inches long, narrower than those of the bay, and more pointed, deep green, with a smooth surface and plain edge; the principal fibres or nerves take their rise from the peduncle. The young leaves are mostly of a reddish hue. The blossoms grow six in number upon slender footstalks, close to the bottom of the leaf. They are monopetalous, small, white, and stellated in six points. The fruit of cinnamon and cassia are very different, according to Gærtner's figure and description. The root is said to contain much camphire. The bark is commonly taken from such of the trees as are a foot or 18 inches diameter; for, when they are younger, it is said to be so thin, as to lose all its qualities very soon. Those trees which grow in a high rocky soil have red shoots, and the bark is superior to that which is produced in a moist clay, where the shoots are green. It is a native of Malabar, Java. Sumatra, chiefly in the northern and central part of the island, in those districts which lie inland of Tappanooly.

The Camphor-Tree is a native of China, Japan, Borneo, and Sumatra. Sir George Staunton found the young shrubs of it growing in the botanic garden of Batavia. He informs us that it is the only species of the laurel genus growing in China, and is there a large and valuable timber-tree. It is used in the best buildings of every kind, as well as for masts of vessels; and bears too high a price to allow of any part, except the branches, being cut up for the sake of the drug, called also camphor, which it affords. This substance is obtained sometimes by boiling the branches, twigs, and leaves, in water; upon the surface of which it is found swimming in the form of an oil; or adhering, in a glutinous form, to a wooden rod, with which the boiling matter is constantly stirred. The glutinous mass is then mixed with clay and lime, and put into an earthen vessel, with another of the same size properly luted over it: the lower vessel being placed over a slow fire, the camphor gradually sublimes through the clay and lime, and adheres to the sides of the upper vessel, forming a cake of a shape corresponding to the cavity which received it. It is, however, less pure, and much weaker, than what is discovered in a solid state among the fibres of the trunk, as turpentine is found in different sorts of pines. In the island of Borneo, and Japan, the camphor-tree is felled for the sole purpose of finding this costly drug in substance among the splinters of the trunk, in the same manner as other trees are felled in Louisiana, merely for collecting the fruit they bear upon their summits.

Native camphor, the *cappoor-barroos* of the Malays, is a production for which Sumatra and Borneo have in all ages been much celebrated; the Arabians being, at a very early period, acquainted with its virtues. Camphor, being of a dry nature, does not exude from the tree, or manifest any appearance on the outside. The natives, from long experience, know whether any is contained within, by striking the tree with a stick. In that case, they cut it down, and split it with wedges into small pieces, finding the camphor in the interstices in the state of a concrete crystallization.

The common SWEET BAY has been celebrated in all ages, and hence is called *nobilis* by Linnæus. In this country it appears as a shrub, but in the southern parts of Europe it becomes a tree of 20 or 30 feet in height.

It is a native of the southern parts of Europe, and of Asia. Ray observed it not uncommon in the woods and hedges in Italy. Holler says it abounds in all the orchards about Moutru, near the lake of Geneva. According to Scopoli, it is found in the woods of Istria. Bolonius remarked it on Mount Ida, and very large trees on mount Athos. St. Pierre observes that fine bay-trees are no-where more common than on the banks of the river Peneus in Thessaly, which might well give occasion to the fable of the metamorphosis of Daphne, daughter of that river. Pallas describes it as a native of the Chersonesus Taurica, &c. It is wild also in the south of France, Spain, Crete, and many parts of the Levant.

The Royal Bay, or Indian laurel, is a large tree with ascending branches. The branches, and particularly the shoots, are tubercled with scars from the fallen leaves; they are alternate, curved inwards, wrinkled and smooth. It is a native of Madeira, the Canary Islands, Virginia, Japan, and Cochin-China. Mr. Miller says it was brought from the Canary Islands to Portugal, where it has been propagated in such great abundance, as to appear now as if it were a native of that country. In the year 1620 it was raised in the Farnesian garden from berries brought from India, and was supposed to be a bastard sort of cinnamon. Loureiro observes, that the wood is of a yellow colour, not heavy, good for building, but better still for furniture. This wood is called *vigniatico* in the island of Madeira, and is probably what is imported into England under the name of Madeira mahogany.

The Sassafras-Tree, *(laurus sassafras,)* is commonly rather a shrub, seldom rising more than 8 or 10 feet high.

Catesby describes the sassafras as a small tree, the trunk as being usually not a foot thick; and the leaves divided into three lobes by very deep incisures. In March, bunches of small five-petalled flowers come forth, succeeded by berries, in size and shape not unlike those of the bay-tree, hanging on red footstalks, with red calyx, resembling that of an acorn; they are at first green, and, when ripe, blue. It is a native of almost all America, commonly in a sandy soil; and was also observed by Loureiro in the north of Cochin-China, near Tonquin. It has withstood the cold of several winters in England, and was cultivated before 1633, at Bow.

The Myrrh-Laurel is a native of Cochin-China.—Loureiro suspects that this may be the plant which affords the true myrrh.

The Laburnum is an elegant tree, and is principally met with in shrubberies and pleasure-grounds. Its wood is so highly prized by cabinet-makers, that a considerable quantity was sold at Brechin castle (Nov. 1819,) at half-a-guinea a foot. Many equally valuable trees might be introduced from New Holland, Van Dieman's Land, and Terra del Fuego.

CORAL-TREE, (*Erythrina.*)

THESE species are all shrubby flowering exotics, and are adorned chiefly with trifoliate or three-lobed leaves, and scarlet spikes of papilionaceous flowers.—They are all natives of the warm parts of Africa and America; and must always be kept in pots, to remain constantly in stoves in England. They are propagated by seeds, annually imported from Africa and America, sown half-an-inch deep in pots of light rich earth, then plunged in the bark-bed of the stove; and when the plants are two inches high, separated into small pots, plunging them also in the bark-bed, giving them frequent waterings, and as they increase in growth shifting them into larger pots.

The inhabitants of Malabar make sheaths of the wood for swords and knives. They use the same, together with the bark, in washing a sort of garments which they call sarassas; and make of the flowers the confection caryl.

LECTURE LXXVIII.

TROPICAL TREES AND PLANTS, (*Continued.*)

PIMENTO, OR JAMAICA-PEPPER.

THIS tree mocks all human labour to extend or improve its growth; not one attempt in fifty being successful to propagate the young plants, or raise them from seeds, in parts of the country where it does not grow spontaneously. The formation of a new pimento plantation (in Jamaica called a walk) is merely to appropriate a piece of woodland, nigh a plantation already existing, or the scattered trees in a native state; the woods being fallen, the trees remain to rot and perish. —In twelve months afterwards, abundance of young pimento plants will be found growing vigorously in all parts of the land; produced from ripe berries scattered there by the birds, while the fallen trees, &c. afford them both shelter and shade. At the end of two years the land being thoroughly cleansed, and only such pimento trees left as appear good, they will soon form groves, and after the first four or five years, require little attention.

Soon after the trees are in blossom, the berries are fit to gather, the fruit not being suffered to ripen on the tree, as the pulp being moist and glutinous, is difficult to cure, and when dry becomes black and tasteless; however, some ripe berries mix with the others; but if the proportion be great, the price of the commodity is injured. It is gathered by the hand; one gatherer on the tree, gathering the small branches, will employ three below (generally women and children) in picking the berries; and an industrious picker will fill a bag of 70lbs. in the day.

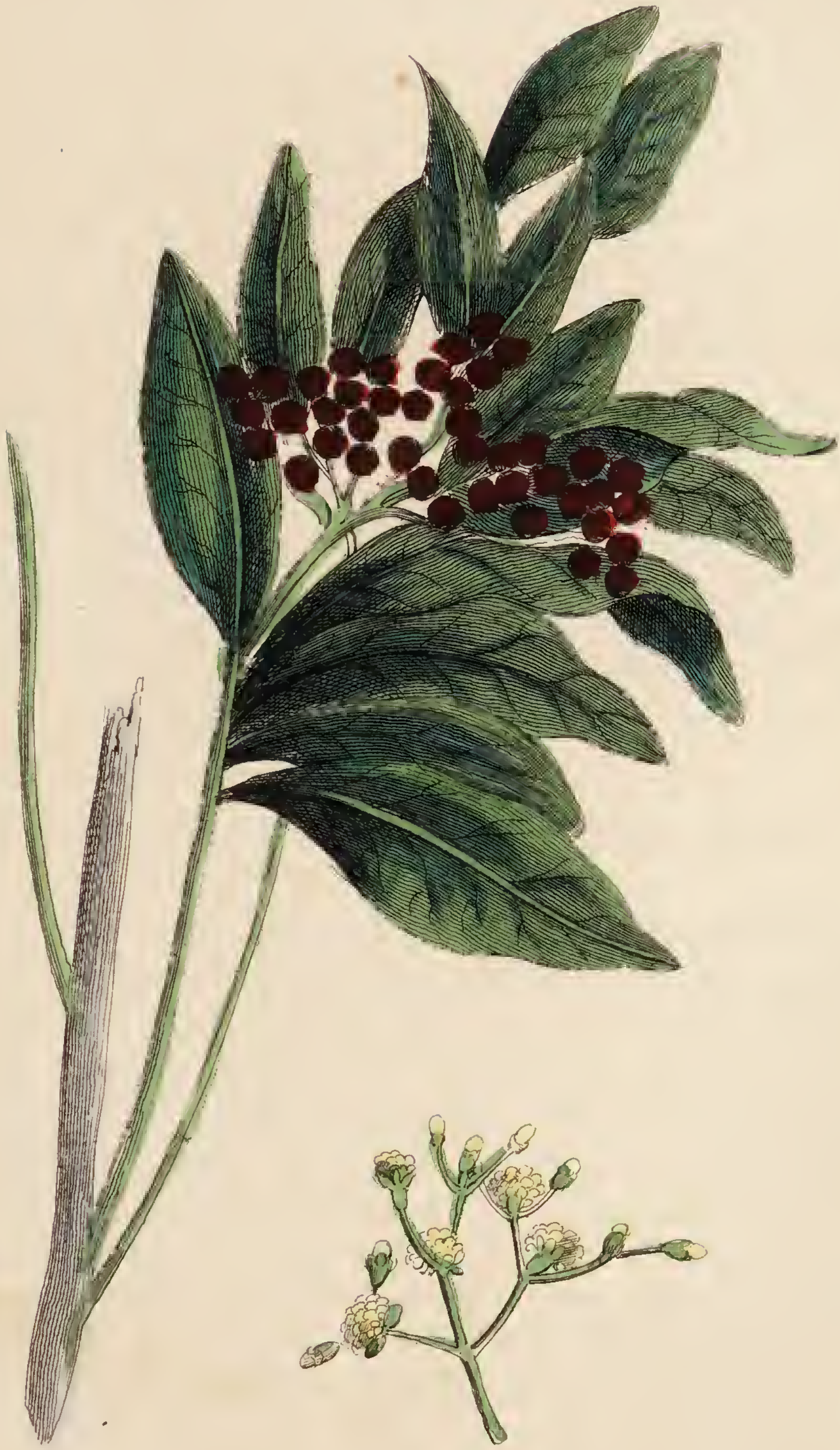
THE EBONY-TREE, *(Ebenus.)*

THE only species, the *Cretica*, is a native of Crete. It rises three or four feet high, with a shrubby stalk, which sends forth several side-branches, garnished at each joint with hoary leaves, composed of five narrow spear-shaped lobes, which join at their tails to the footstalk, and spread out like the fingers of a hand. The branches are terminated by thick spikes of large purple flowers, of the butterfly or pea-bloom kind. The plants may be propagated from seeds sown in autumn. In this country the plants must be protected during winter, as they are unable to bear the cold.

Travellers differ in accounts of the tree that yields the black ebony. Some make it a sort of palm-tree; others, a cytisus, &c. The most authentic is that of M. Flacourt, many years governor of Madagascar. He asserts that it grows very high and large, its bark being black, and its leaves resembling those of our myrtle, of a deep dusky green. Tavernier says the islanders always take care to bury their trees, when cut down, to make them blacker, and prevent their splitting when wrought. Plumier mentions another black ebony-tree, discovered by him at St. Domingo, which he calls *spartium portulacæ foliis aculeatum ebeni materiæ.* Candia ash bears the little shrub *Ebenus Cretica.*

THE FOUNTAIN-TREE

GROWS in the Canary islands, and distils water from its leaves so plentifully as to answer all the purposes of the



Myrtus Pimenta _ Pimento, Jamaica Pepper *or* Allspice.

London, Published by Sir R. Phillips & C.º Feb. 10. 1823.

inhabitants who live near it. "There are," says Glasse, "only three fountains of water in the whole island of Hierro, wherein the fountain-tree grows. One of these fountains is called *Acof*, which, in the language of the ancient inhabitants, signifies river; a name, however, which does not seem to have been given it on account of its yielding much water, for in that respect it hardly deserves the name of a fountain. To the northward is another, called *Hapio;* and in the middle of the island is a spring, yielding a pure stream This was discovered in 1565, and is called the fountain of *Hernandez*. On account of the scarcity of water, the sheep, goats, and swine, here do not drink in the summer, but are taught to dig up the roots of fern, and chew them to quench their thirst. The great cattle are watered at these fountains, and at a place where water distils from the leaves of a tree."

Trees yielding water, however, are not peculiar to the island of Hierro; for travellers inform us of one of the same kind on the island of St. Thomas, in the bight or gulf of Guinea; and in Cockburn's voyages, we find an account of a dropping tree, near the mountains of Fera Paz, in America.

THE WAX-BEARING MYRICA, OR CANDLEBERRY-MYRTLE, *(Cerifera.)*

A NATIVE of North America, is a small tree about ten or twelve feet high, with crooked stems branching forth near the ground irregularly; the leaves grow irregularly on them all round; sometimes by pairs, sometimes alternately, but generally at unequal distances. They are lanceolated; some are serrated at the top, others have their edges entire. They stand on very short footstalks; having their upper surface smooth, and of a shining green colour, whilst their under is of a more dusky hue. The branches of the old plants shed their leaves in autumn; but the young plants raised from seeds retain them most of the winter, so as during that season to appear like an evergreen. But this beauty is not lasting, for they shed their leaves proportionally earlier as the plants get older. There are both male and female trees of this sort: the flowers are small, of a whitish colour, and make no figure; neither does the fruit that succeeds the female, a small, dry, blue-berry, though produced in clusters, make any shew: so that from the leaves this tree receives its beauty and value; for these being bruised, as well as the bark of the young shoots, emit a refreshing and delightful fragrance, not exceeded by myrtle, or any other aromatic shrub.

There is a variety of this species of lower growth, with shorter but broader leaves, and of equal fragrance. This grows commonly in Carolina; where the inhabitants collect from its berries a wax, of which they make candles, and which occasions its being called the candleberry-tree. The wax is procured in the following manner: In November and December, when the berries are ripe, a man with his family will remove from home to some island, or sand-bank, near the sea, where these trees abound, taking with them kettles to boil the berries in. He builds a hut with palmetto-leaves, to shelter himself and family during his residence there, which is commonly four or five weeks. The man cuts down the trees, while the children strip off the berries into a porridge-pot; and having put water to them, they boil them till the oil floats, which is then skimmed off into another vessel. This is repeated till no more oil appears. When cold, this hardens to the consistence of wax, and is of a dirty green colour.—It is then boiled again, and clarified in brass kettles, which gives it a transparent greenness. These candles burn a long time, and yield a grateful smell.

INDIAN ARROW-ROOT, *(Maranta.)*

ALL the species are herbaceous perennial exotics of the Indies, kept here in hot-houses for curiosity: they have thick, knotty, creeping-roots, crowned with long, broad, arundinaceous pointed leaves, and upright stalks, half a yard high, terminated by bunches of monopetalous, ringent, five-parted flowers. They are propagated by parting the roots in spring, planting in pots of light rich earth, and plunging in the bark-bed. The root being used by the Indians to extract the virus communicated by poisoned arrows, gives it the name of arrow-root. The starch plant is two feet high, broad pointed leaves, small white flowers, and one seed. It is cultivated in gardens and provision-grounds in the

West Indies; and the starch is obtained by the following process. The roots a year old are dug up, well-washed, and then beaten in deep wooden mortars to a pulp; which is thrown into a large tub of clean water. The whole is then well stirred, and the fibrous part wrung out by the hands, and thrown away. The milky liquor is passed through a hair-sieve, settles, and the clear water is drained off; leaving at the bottom of the vessel a white mass, which is again mixed with clean water and drained: and the mass is dried in the sun, and is pure starch.

THE TAMARIND-TREE, *(Tamarindus,)*

Is a native of both Indies, America, Arabia, and Egypt, and was cultivated in Britain before 1633. It rises to the height of thirty or forty feet, sending off numerous large branches, which spread to a considerable extent, and have a beautiful appearance; the trunk is erect, and covered with rough greyish or ash-coloured bark; the leaves small and pinnated, and yellowish green; the flowers grow in lateral clusters, resembling the papilionaceous; the calyx consists of four leaves, and the corolla of three yellowish petals, beautifully diversified with red veins: the fruit is a pod of a roundish compressed form, from three to five inches long, containing two, three, or four seeds, lodged in a dark pulpy matter. —The flowers appear, in some parts, according to Jacquin, in October and November; but, according to Dr. Wright, they continue during June and July, and then drop off.

The pulp of the tamarind, with the seeds connected by tough fibres, are brought freed from the outer shell, and preserved in syrup. Long says, tamarinds are thus prepared for exportation at Jamaica; the pods are gathered when full ripe, known by their easy breaking on small pressure between the finger and thumb. The fruit, cleared from the shelly fragments, is placed in layers in a cask; and covered with boiling syrup, just before it begins to granulate, this syrup pervades every part, and when cool the cask is headed for sale. The fruit produced in the East Indies is more esteemed than that of the West, and easily distinguished by the greater length of the pods, and the pulp being drier and of a darker colour.

THE SILVER-TREE, *(Protea.)*

THE *argentea*, or common Silver-Tree, has a strong upright stem covered with purple bark, dividing into several erect branches, garnished with broad, shining, silvery leaves, which it exhibits throughout the whole year. It has at first a very uncommon and beautiful appearance, and in twelve or fifteen years rises to the height of twenty feet. In a rich soil these trees grow quick, and are the largest of the kind. They are generally planted near farms, and seldom grow wild.—Sparrman thinks they were probably brought to the Cape of Good Hope from Anamaqua; for he travelled over the whole north-east side of Hottentot Holland, without finding it either wild or planted.

THE BALSAM OF TOLU TREE, *(Toluifera.)*

THIS tree grows to a considerable height; sends off large branches, and is covered with rough, thick, grey bark; the leaves are light green, ovate, entire, pointed, alternate, upon short strong footstalks; the stigma pointed; and the fruit is a round berry. It grows in Spanish America, in Tolu, behind Carthagena; whence the balsam is deposited in little gourd-shells. It is obtained by making incisions in the bark of the tree, and is collected into spoons made of black wax, from which it is poured into proper vessels.

THE POMEGRANATE-TREE, *(Punica.)*

THE *granatum*, or Common Pomegranate, rises with a tree stem eighteen or twenty feet high, branching numerously from the bottom; with spear-shaped narrow opposite leaves. The branches are terminated by beautiful large red flowers, which are succeeded by large round fruit, the size of an orange, having a hard rind filled with soft pulp and numerous seeds.

The *nana*, or Dwarf American Pomegranate, rises with a shrubby stem, branching four or five feet high, with narrow short leaves and small red flowers, succeeded by small fruit; it begins flowering in June, and continues till October. Both species are propagated by layers of the young branches, in autumn.

LECTURE LXXIX.

TROPICAL TREES AND PLANTS, (*Continued.*)

THE BREAD-FRUIT TREE, (*Artocarpus*,)

HAS a cylindric amentum, or catkin, which thickens gradually, and is covered with flowers; the male and female are in a different amentum. In the male, the calyx is two-valved, and the corolla is wanting. In the female, there is no calyx nor corolla; the stylus is one, and the drupa many-celled.

There are two species, viz. the incisus, with gashed leaves; and the integrifolia, with entire leaves. There is also another distinction, into that which bears fruit with stones or seeds, and that in which the fruit has none. The parts of fructification of that tree which bears the fruit without stones, are defective. The amentum, or catkin, which contains the male parts, never expands. The styli, or female part of the fruit, are likewise deficient; hence there can be no stones or seeds, and therefore this tree can be propagated only by suckers, or layers; although it evidently must have proceeded from the seed-bearing bread-fruit tree.

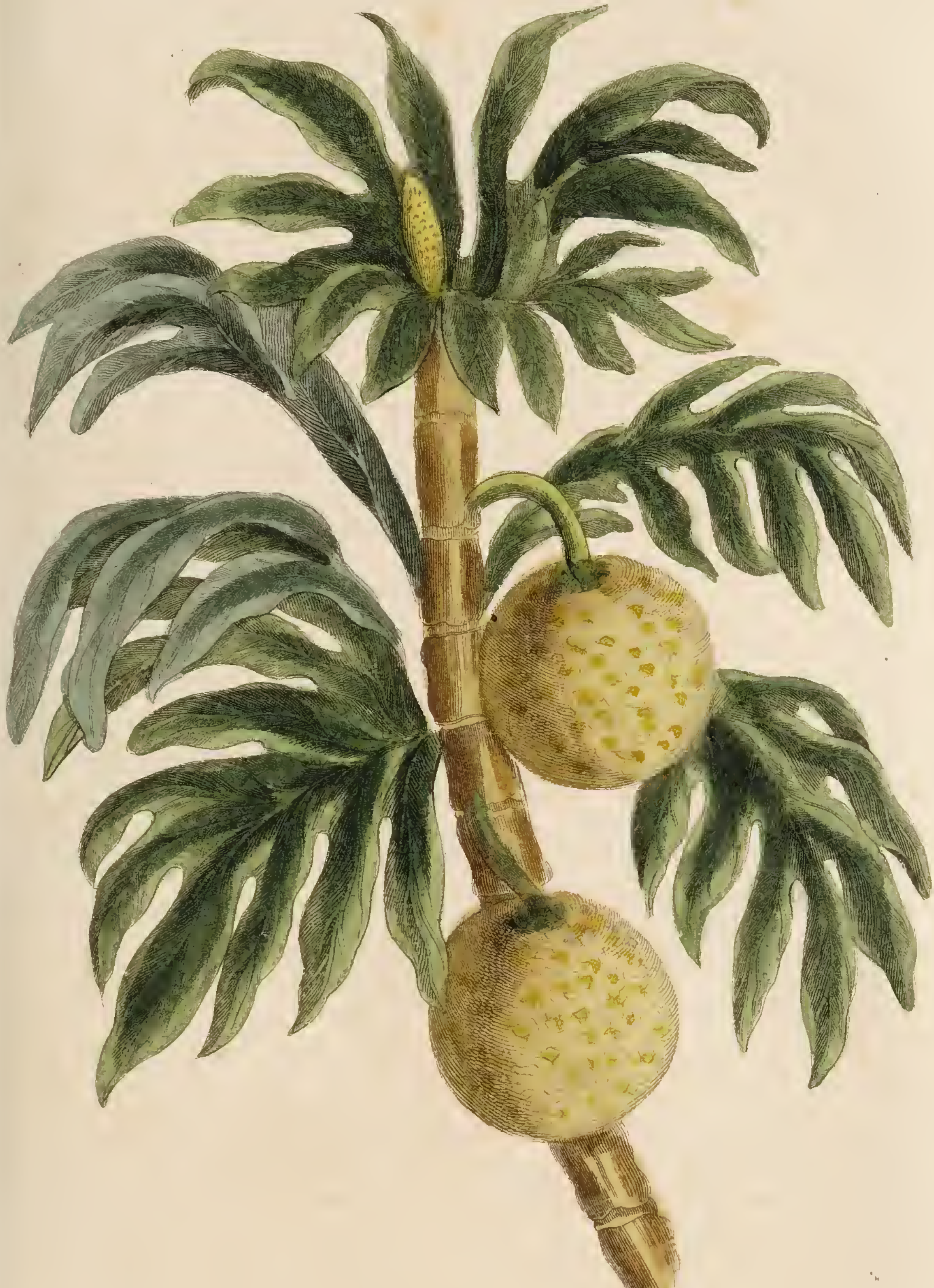
Dr. Solander was assured, by the oldest inhabitants of Otaheite and the adjoining islands, that they well remembered there being formerly plenty of the seed-bearing bread-fruit; but it had been neglected through the preference given to the bread-fruit without seeds, which they propagate by suckers.

Captain Cook observes, that this fruit not only serves as a substitute for bread among the inhabitants of Otaheite and the neighbouring islands, but also, variously dressed, composes the principal part of their food. It grows on a tree, the size of a middling oak; its oblong leaves are frequently eighteen inches long, deeply situated, and like those of the fig-tree in colour, consistence, and in exuding a milky juice, when broken. The fruit is the size and shape of a child's head; and the surface reticulated, not unlike a truffle; it is covered with a thin skin, and has a core as large as the handle of a small knife. The eatable part lies between the skin and the core; is as white as snow, and of the consistence of new bread; it is divided into three or four parts, and roasted before it is eaten; its taste is insipid, with a slight sweetness resembling that of the crumb of wheaten bread mixed with a Jerusalem artichoke. This fruit is also cooked in a oven, which renders it soft, and like a boiled potatoe, but less farinaceous than a good one. Of the bread-fruit three dishes are made, by putting either water or the cocoa-nut milk to it, then beating it to a paste with a stone pestle, and afterwards mixing it with ripe plantains, bananas, or the sour paste called *mahie*.

The mahie, (likewise a succedaneum for ripe bread-fruit before the season comes on,) is thus made; the fruit of the bread-tree is gathered just before it is perfectly ripe, laid in heaps, closely covered with leaves; it thus ferments, and becomes disagreeably sweet; the core is then taken out entire, by gently pulling the stalk, and the fruit is thrown into a hole dug in the houses, and neatly lined in the bottom and sides with grass: the whole then, covered with leaves and heavy stones, undergoes a second fermentation, and becomes sour, but suffers no further change for many months. It is taken out of the hole as it is wanted for use; and being made into balls, is wrapped up in leaves and baked; and will keep five or six weeks. It is eaten both cold and hot; and the natives seldom make a meal without it, though, to Europeans, the taste is as disagreeable as that of a pickled olive generally is the first time it is eaten. The fruit itself is in season eight months in the year, and the mahie supplies the inhabitants during the other four.

To procure this principal article of their food, the bread-fruit costs these happy people no trouble or labour, except climbing a tree. The tree, however, does not grow spontaneously; but if a man plants ten in his life-time, which he may do in an hour, he will as completely fulfil his duty to his own and future generations, as the native of our less temperate climate can do by ploughing in the cold of winter, and reaping in the summer's heat, as often as these seasons return; even if, after he has procured bread for his present household, he should convert a surplus into money, and lay it up for his children.

The vegetable creation, says Mr. Bucke, is of far greater use for food to man, than is the animal; and, if we except the natives of the Arctic regions, who never saw a tree, nor tasted vegetable food, to all the other inhabitants of the earth, vegetables are extremely useful. The Caffres make bread of the palm-tree, by extracting the pith, keeping it till sour, and then baking it.—Humboldt says, one acre of the banana yields above twenty times the aliment which the same space would afford planted with maize, rice, or wheat. On the Congo, the mangrove burns better in a green state than in a dry one; there is also a plant which burns like oil, furnishing both the oil and wick; the berries of another plant make excellent candles; while the Bay of St. Barnabe, in the Gulf of California, abounds in plums, which yield, instead of gum or resin, a fragrant incense. The cocoa, when old, yields a species of oil used for light; of its juices toddy is made; the cabbage answers many culinary, and the leaf many mechanical purposes; the shell is used for domestic utensils, the fibres for cordage, and the trunk for building; a ship is not only built but entirely rigged out of cocoa-trees. The uses and virtues of the plantain are many; it produces the most healthful food in its mealy and saccharine fruit; one cluster is no inconsiderable load



BREAD FRUIT TREE.

London Published by Sir R. Phillips & C.o Feb. 10. 1823.

Neele & [illegible] Strand

for a man; a single fruit furnishes a meal, and a bunch is food for a day; the flavour supplies the want of butter, sugar, spices, and all the delicacies of pastry. Those of the bread-fruit tree are still more important; it supports the most abundant population, (according to Foster, who, comparing the parts of Otaheite, best cultivated with those of France, under the same circumstances, supposed it to that of the latter as 17 to 1;) when ripe is soft, yellow, sweetish, without seed or stone, but a fine substance like bread, and in season eight months of the year. Thus do the plantain, cocoa, palm, and bread-fruit tree, furnish the chief means of existence in the countries where they grow. To these we shall add the *shea*, which furnishes excellent butter from its kernel, by Park considered as whiter, firmer, and better than from milk; it keeps all the year without salt. The cream-fruit of Sierra Leone affords a similar sweetish fluid. The *palo de vaca*, or milk-tree, on being pierced in the trunk at sun-rise, supplies a sweet and most nutritive juice, having a balsamic perfume, with many of the qualities of milk; hence it is visited by the natives, who in vessels of shells, calabashes, and cocoa-nuts, convey the milk home to their offspring.

THE PLANTAIN-TREE

Is cultivated in all the islands of the West Indies, where the fruit serves the Indians for bread. It rises with a soft stalk, fifteen or twenty feet high. The leaves shoot forth on every side, and are often eight feet long, and from two to three feet broad, with a strong fleshy midrib, and a great number of transverse veins running from the midrib to the borders. The leaves are thin and tender, so that when they are exposed to the air, they are generally torn by the wind: their leaves come out from the centre of the stalk, and are rolled up at their first appearance; but when they are advanced above the stalk they expand, and turn backwards. As these leaves come up rolled, in the manner before-mentioned, their advance upward is so quick that their growth may be almost discerned with the naked eye; and if a fine line is drawn across level with the top of the leaf, in an hour's time the leaf will be nearly an inch from it. When the plant has attained its full height, the spikes of flowers appear in its centre, which is often four feet in length. The flowers blow in bunches; those in the lower part of the spike being the largest. Each of these bunches is covered with a spathe or sheath of a fine purple colour, which drops off when the flower opens. The fruit, or plantains, are about a foot long, and from one to two inches in diameter: it is at first green, but when ripe, of a pale yellow colour. The skin is tough, and within is a soft pulp, of a luscious sweet flavour. The spikes of fruit are often so large as to weigh upwards of forty pounds.

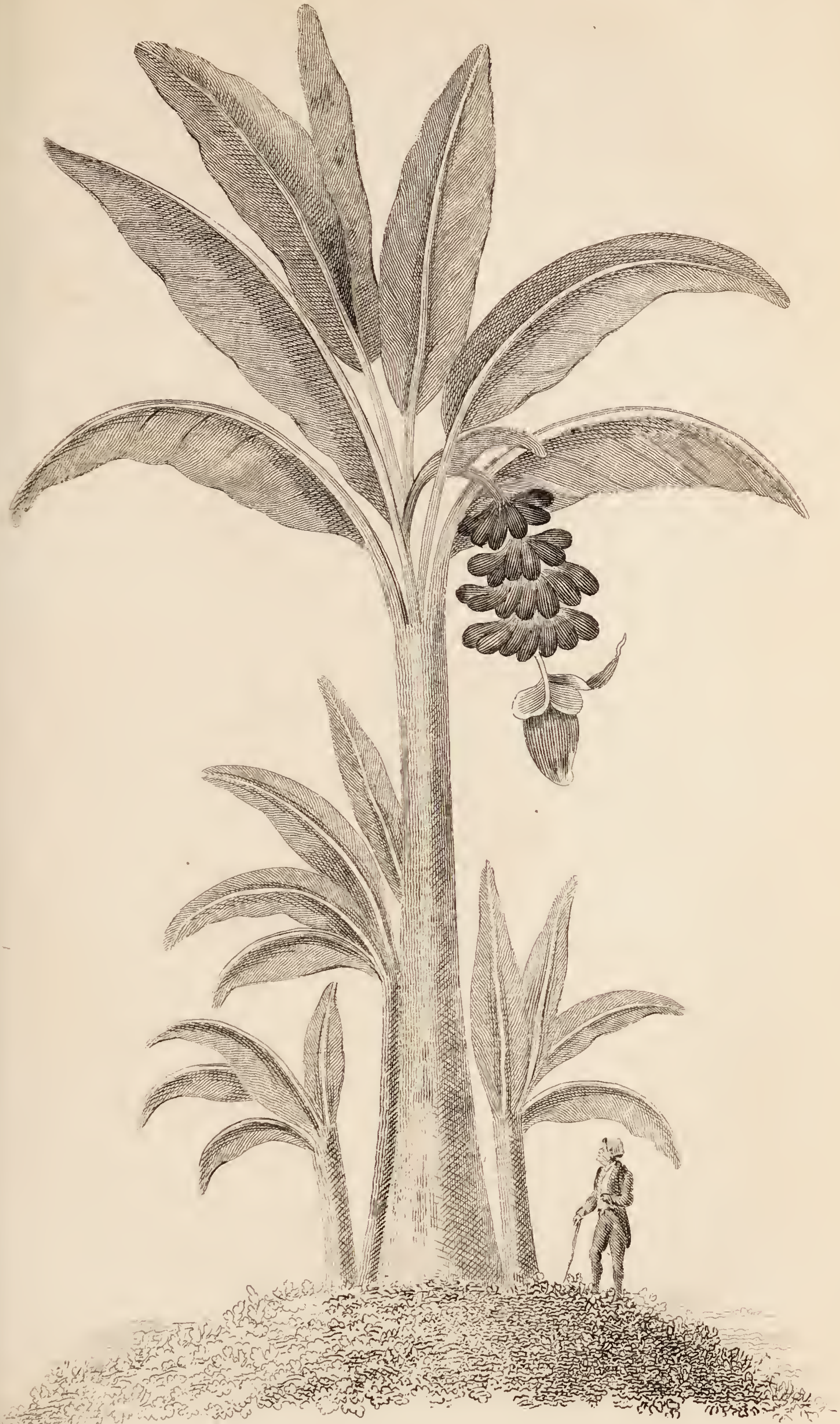
This tree is cultivated on a very extensive scale in Jamaica; without the fruit of which, says Dr. Wright, the island would scarcely be habitable, as no species of provision could supply their place. Plantains also fatten horses, cattle, swine, dogs, fowls, and other domestic animals.

THE BANANA-TREE

Differs from the preceding, in having its stalks marked with dark purple stripes and spots. The fruit is shorter, straighter, and rounder: the pulp is softer, and of a more luscious taste. It is never eaten green; but when ripe, it is very agreeable, and is held in high estimation in the West Indies. Both the plantain and banana were carried to the West Indies, from the Canary Islands, whither they had been brought from Guinea, where they grow naturally. They are also cultivated in Egypt, and in most hot countries, where they grow to perfection. When their stalks are cut down, several suckers come up from the root, which in six or eight months produce fruit; so that by cutting down the stalks at different periods, there is a constant succession of fruit throughout the year.

The fruit of the banana is four or five inches long, of the size and shape of a middling cucumber, and of a high grateful flavour: the leaves are two yards long, and a foot broad in the middle; they join to the top of the body of the tree, and frequently contain in their cavities a great quantity of water, which runs out, upon a small incision being made into the tree, at the junction of the leaves. The fruit grows in great bunches, which weigh a dozen pounds and upwards.—The body of the tree is very porous; the tree is only perennial by its roots, and dies to the ground every autumn.

When the natives of the West Indies, (says Labat,) undertake a voyage, they make provision of a paste of the banana, which serves them for nourishment and drink. The banana is much



PLANTAIN TREE.

esteemed, and even venerated, by the natives of Madeira, who term it the forbidden fruit, and reckon it an almost inexpiable crime to cut down the tree. Some authors have imagined that the banana-tree was that of the leaves with which Adam and Eve clothed themselves in paradise, as they may easily be joined.

THE ELM-LEAVED SUMACH

GROWS naturally in Italy, Spain, Turkey, Syria, and Palestine. The branches are used instead of oak-bark for tanning leather; and the Turkey leather is entirely tanned with this shrub. It has a ligneous stalk, divided at bottom into many irregular branches, rising eight or ten feet high; the bark is hairy, of an herbaceous brown colour; the leaves are yellowish green winged, of seven or eight pair of lobes, terminated by an odd one, bluntly sawed on the edges, with the under side hairy, and placed alternately on the branches, at whose end the flowers grow in loose panicles of a whitish herbaceous colour, each panicle being composed of several spikes of flowers sitting close to the footstalks.

THE VIRGINIAN SUMACH, OR VINEGAR-PLANT,

GROWS naturally in most parts of North America, and has a woody stem, with several branches, which are generally crooked and deformed. The young branches are covered with a soft velvet-like down, both in colour and texture resembling that of a young stag's horn, whence the vulgar appellation of stag's-horn; the leaves are winged, of six or seven pair of oblong heart-shaped lobes, terminated by an odd one, ending in acute points, hairy on their underside, as is also the mid-rib. The flowers are produced in close tufts at the end of the branches, and are followed by seeds, inclosed in purple woolly succulent covers; so that the bunches are of a beautiful purple colour in autumn; and the leaves in autumn, change to a purplish colour at first, and before they fall to a feuillemort.

This plant has been long cultivated in the north of Germany and lately in Russia. It has the name of the vinegar-plant from the double reason; of the young germen of its fruit, when fermented, producing either new, or adding to the strength of old weak vinegar, whilst its ripe berries afford an agreeable acid, which might supply the place, when necessary, of the citric acid. The powerful astringency of this plant renders it useful in several of the arts. The ripe berries boiled with alum make a good dye for hats. The plant in all its parts may be used as a succedaneum for oak-bark, in tanning, especially the white glove leather.—The milky juice from incisions in the trunk or branches, makes, when dried, the basis of a varnish little inferior to the Chinese.—Bees are remarkably fond of its flowers; and it affords more honey than any of the flowering shrubs, so that it may prove a useful branch of economy, where rearing these insects is an object. The natives of America use the dried leaves as tobacco.

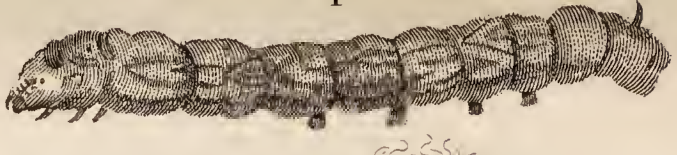
GREAT AMERICAN-ALOE.

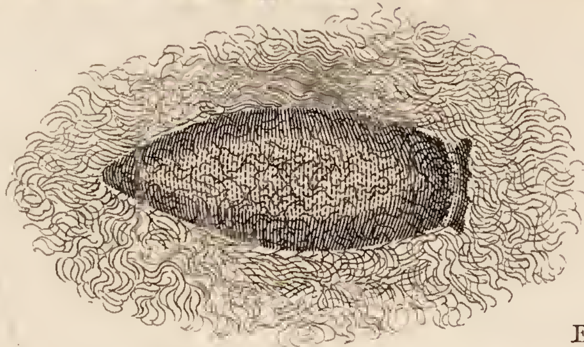
THE stems rise twenty feet high, and branch out on every side towards the top, forming a pyramid; the slender shoots are garnished with greenish yellow flowers, erect, and in thick clusters at every joint, which have a beautiful appearance. They continue long in beauty by a succession of new flowers, for nearly three months, in favourable seasons. The seeds do not ripen in England. The supposition is erroneous that these plants do not flower till they are one hundred years old; for that time depends on their growth; in hot countries, where they grow quickly, and expand many leaves every season, they flower in a few years; but in colder climates, their growth is slow, hence it is much longer before they shoot up their stems. A variety with striped leaves, is common in the English gardens; the other sorts are so tender as to require to be constantly in the stove.

THE SPONGE PLANT,

A MARINE production, is obtained on the coast of the newly acquired island of Singapore. In its form it resembles that kind of drinking-cup called a goblet, with a well-defined base or root, a cylindrical stem, and a capacious bowl or cup. Its texture is non-elastic, composed of numerous tubes or anastomosing cells; the external surface, or epidermis, is not thicker than the coats of the tubes, and is covered with innumerable stellated pores, which under a lens appear to be the mouths of as many vessels, and ramifications of the internal structure. The root is formed of several irregular perpendicular shoots, in their origin apparently cellular, but is enlarged by an accumulation of earthy, sandy particles, and broken in shells, and rather fragile. The bowl is circular or sub-conical, with several nodes or protuberances, and covered both within and without

Banana





Silk Ball _ 2d state

Moth

Eggs

4th state

Mangrove

with circular pores of various diameter, whose mouths are closed with fine cottony fibres, radiating from the circumference to the centre; and the same fibrous substance extends over the surface of the bowl, giving it a tomentous appearance, when viewed under a lens of common powers. The stem is cylindrical, of proportional height and thickness, and of the same cellular substance as the bowl.

The foregoing description is taken from a specimen whose dimensions are; the greatest diameter of the bowl at its brim 17 inches; the smallest at the bottom 7½, in the middle 12½; the circumference of the stem 17, but near the root is a tumescence increasing it to a larger dimension. The cavity is capable of containing 36 quarts. Colonel Hardwicke observes, that in an essay on British sponges, by George Montague, Esq. in vol. 2 of the Transactions of the Wernerian Society, is described a sponge, under the specific denomination of *scypha*, and this sponge in its character has affinity to the subject here mentioned. The Indian species, however, is gigantic in all its parts, compared with *spongia scypha*, and a more appropriate specific distinction may perhaps be given to this, in denominating it *spongia patera*, The goblet sponge.

CIPO.

THIS curious plant grows abundantly between Monte Santo and the river Bendegó, in Brazil. It is a climbing plant, destitute of leaves, and contains a milky juice, like an *euphorbium*; it bears no thorns, but often grows so as to form an impenetrable *plica*, which the cattle will seldom approach, much less attempt to break through, because, when the juice of this plant sticks to their hair, it occasions blisters and great irritation.—Mornay made a cut at the bush with his hanger, in the dusk of the evening, when the wounds inflicted presented a beautiful luminous line, which was not transient, but lasted for several seconds, or a quarter of a minute.—Having taken a piece of the plant and bent it in the dark until the skin cracked, every crack shewed the same light, which is of a phosphorescent appearance; continuing to bend the twig until the milky juice dropped out, each drop was a drop of fire, very much like that seen on dropping inflamed tallow; but without any particular smell. The milky juice is very poisonous and caustic, and occasions much itching and irritation, when applied to the skin. It becomes viscous in the air, and soon dries, of a yellowish colour, slightly tinged with green, when it has the appearance of a gum-resin.

The ANISATUM, or *Anise Tree*, a native of China and Japan, rises with an erect branched stem; and is covered with an ash-coloured bark, under which is another bark, green, fleshy, mucous, and aromatic, combined with a slight astringency. The wood is hard and brittle; the pith little fungous, and of a green herbaceous colour. The leaves resemble those of laurel, and the flowers, those of narcissus, but they stand single, of a pale white, sixteen petals, differing in form. The extremity of the flower-stalk continued into the germen of the flower, forms eight conjoined capsules; some of these frequently decay; the others inclose each a single seed, resembling that of the *palma christi*, and which, when the hard corticle is broken, exhibits a soft and white kernel.

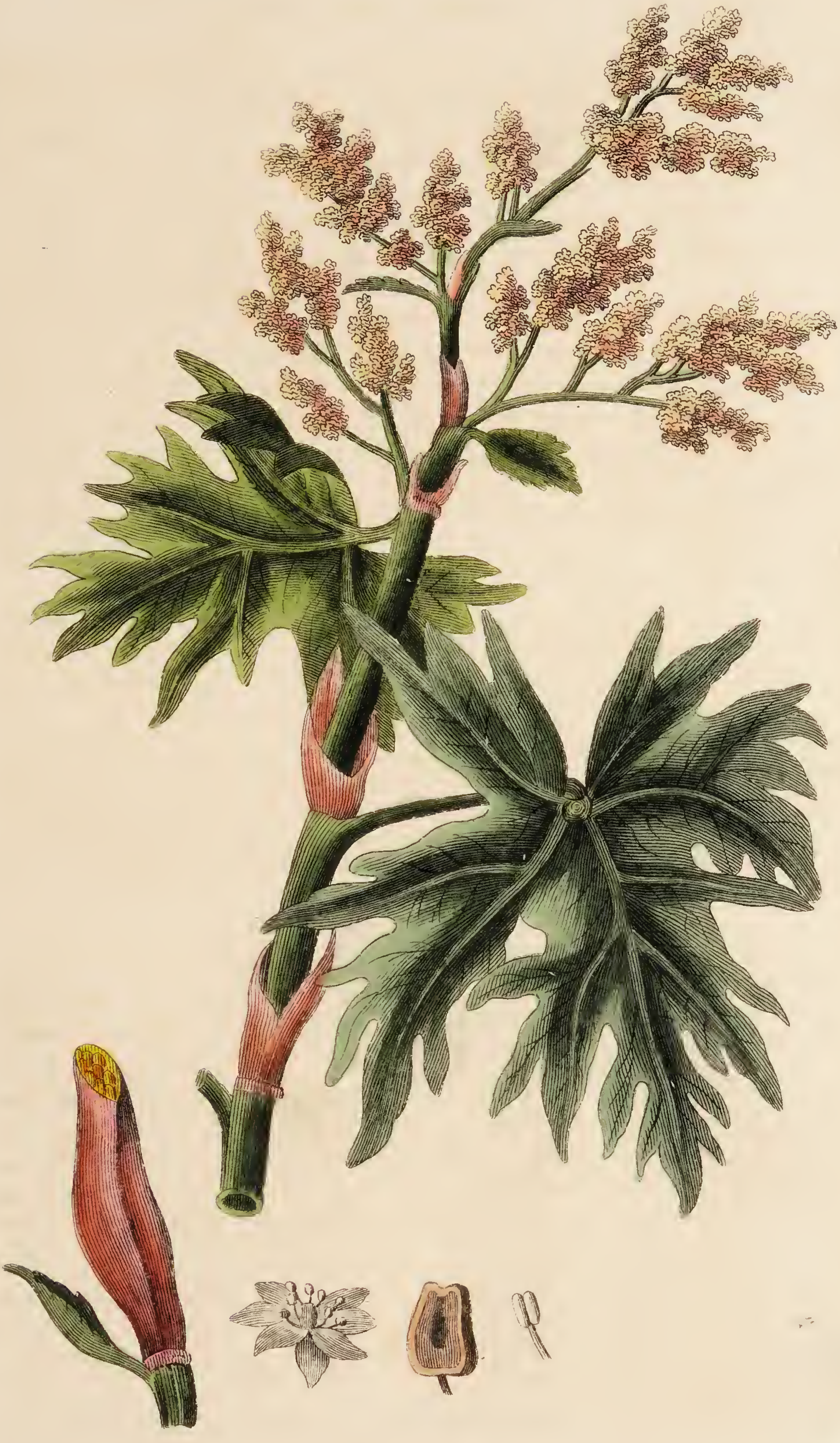
The bonzes of China and Japan persuade the inhabitants that the gods are delighted with the presence of this tree; and place before their idols garlands and bundles of the branches. The Brahmins inculcate into the Indians a similar opinion of the Malabar fig, or *ficus religiosa*. The bark of the anise-tree, reduced to powder, and equally burnt, the public watchmen in Japan, by a very curious contrivance described by Kempfer, render useful in the measuring of time during the da kness of the night. The same powder is frequently burnt in brazen vessels on the Japanese altars, and as incense is in other countries.

RHUBARB, *(Rheum.)*

THE Common Rhubarb, *(rhaponticum,)* has a large, thick, fleshy, branching, deeply-striking root, yellowish within; it is crowned by very large, roundish, heart-shaped smooth leaves, on thick, slightly-furrowed, foot-stalks; and an upright strong stem, two or three feet high, adorned with leaves singly, and terminated by thick close spikes of white flowers. It grows in Thrace and Scythia, but has been long in the English gardens.

The Palmated-leaved true Chinese Rhubarb, *(palmatum,)* has a thick fleshy root, yellow within; crowned with very large palmated leaves, deeply divided into acuminated segments, expanded like an open hand; upright stems, six feet high, terminated by large spikes of flowers.

The Tartarian Rhubarb has a large, fleshy, branched



Rheum Palmatum. Palmated *or* officinal Rhubarb.

Neele & [illegible] Strand.

London. Published by Sir R. Phillips & Co. Feb. 10. 1823.

root, yellow within; crowned by very large, heart-shaped, lobated, sharply indented, smooth leaves, and an upright large stem, six feet high, garnished with leaves singly, and branching above; having all the branches terminated by nodding panicles of white flowers.

The Undulated, or Waved-leaved Chinese Rhubarb, has a thick, branchy, deep-striking root, yellow within; crowned with large, oblong, undulate hairy leaves, having equal foot-stalks, and an upright firm stem, four feet high; garnished with leaves singly, and terminated by long loose spikes of white flowers.

The Currant Rhubarb of Mount Libanus, has a thick fleshy root, very broad leaves, full of granulated protuberances, and with equal foot-stalks, and upright firm stems, three or four feet high, terminated by spikes of flowers, succeeded by berry-like seeds, surrounded by a purple pulp.

All these plants are perennial in root, with the leaves and stalks annual. The roots being thick, fleshy, generally divided, strike deep into the ground; of a brownish colour without and yellow within; the leaves rise in spring, generally come up in a large head folded together, gradually expanding, having thick foot-stalks; and grow two feet high, in length and breadth, spreading all round; amidst them rise the flower-stems, garnished at each joint by one leaf, and of strong and expeditious growth, attaining their full height in June, when they flower; and are succeeded by large triangular seeds, ripe in August. Some plants of each sort merit culture in gardens for variety; they will effect a singularity with their luxuriant foliage, spikes, and flowers; and, as medical plants, they demand culture for both private and public use.

Bell gives some curious particulars relating to the culture of rhubarb:—The best rhubarb grows in that part of Eastern Tartary called Mongalia, now the boundary between Russia and China. The marmots contribute greatly to its culture. Wherever ten or twenty plants grow, may be found several burrows under the shades of their broad-spreading leaves. Though they may sometimes eat the leaves and roots, probably the manure they leave about the roots contributes much to its increase; and as they cast up the earth, young buds shoot out and multiply.—This plant does not run, and spread itself, like docks, and others of the same kind; but grows in tufts, at uncertain distances, as if the seeds had been dropped with design. The Mongals never accounted it worth cultivating: but the world is obliged to the marmots for the quantities scattered, at random, in many parts of this country; for whatever part of the ripe seed may be blown among the thick grass, can seldom reach the ground, but withers and dies: whereas, when it falls among the loose earth thrown up by the marmots, it immediately takes root, and produces a new plant.

After digging and gathering the rhubarb, the Mongals cut the large roots into small pieces, to dry them more readily. In the middle of every piece they scoop a hole, through which a cord is drawn, to suspend them in any convenient place, mostly about their tents, though sometimes on the horns of their sheep.

LECTURE LXXX.

TROPICAL TREES AND PLANTS, (*Continued.*)

THE OLIVE.

> See the young olive in the sylvan scene,
> Crown'd by fresh fountains with eternal green,
> Lifts the gay head in snowy flow'rets fair,
> And plays and dances to the gentle air;
> When lo! a whirlwind from high heav'n invades
> The tender plant, and withers all its shades·
> It lies uprooted from its genial bed,
> A lovely ruin, now defaced and dead.
>
> POPE'S HOMER.

THE varieties of this tree are numerous. Indeed, some of them may rather be considered as species, since in France, Italy, and Spain, there are many varieties or subvarieties (as we must now call them) of these. Thus, in Languedoc, the species called the *cormeau*, the *ampoulan*, and the *moureau*, are chiefly cultivated; in Provence the small oblong, the oblong dark-green, the small roundish white, or *aglandan*, the large fleshy or royal, the large roundish, and the small round reddish-black olive are cultivated. In Spain they have several varieties of their large fruit. In Italy, the small Lucca olive is much esteemed; and in the southern provinces of the kingdom of Naples, where this tree is much cultivated, is the Salentine olive, called by the peasants *ogliarola*. *Cellina*, *scuranse*, or *cascia*, yield less oil than the first in the proportion of two to three; but the tree grows to a greater size, resists weather better, and is more fruitful.

The Cape Olive is a small tree, or rather shrub. The leaves are commonly entire, dense, and rigid, always paler underneath, with oblique smooth veins, which are less conspicuous underneath than above. From the axils, and at the end of the branches, the flowers come out in the racemes in June and July; they are sometimes thinly disposed, but sometimes so numerous that the racemes hang down; the corolla is white, and small. It is a native of the Cape of Good Hope. It was cultivated in 1732 by Sherard, and Dillenies speaks of the plant at Eltham, as being, then, ten or eleven years old.

Osbeck mentions the Sweet-scented Olive, or *quai-fa*, as one of the ornamental trees in the Chinese gardens. He says it is about six yards high; with small, white, sweet-scented flowers, three or four in one involucre. It is chiefly valuable for the fragrance of its flowers, which to the eye are but insignificant. The flowers of this plant, and of the *chleranthus inconspicuus*, are both said to be added to the tea in China, to improve its flavour.

The olive will grow in almost any soil; but, when it is planted in rich moist ground, the tree grows larger, and makes a finer appearance, than in poor land; yet the oil is not so good as in a leaner soil. Calcareous ground is esteemed the best for these trees; the oil being finer, and keeping longer, than in any other.—Accordingly, we commonly find the olive in the south of Europe, on white marl or potter's-clay, or on limestone-rock, in mountainous situations, unfit for vines.

These trees are generally brought over from Italy every spring, by the persons who import orange-trees, jasmines, &c. from whom they may be easily procured; which is a better method than to raise them from layers in this country, that method being too tedious; and those which are thus brought over have many times very large stems, to which size young plants in this country would not arrive in ten or twelve years.

The olive was cultivated at Oxford, in 1648; and several olive-trees were planted against a warm wall at Camden-house, near Kensington, which succeeded very well till their tops advanced above the wall; after which, they were generally cut down to the top of the wall in winter. These n 1719 produced a fine display of fruit, which grew so large as to be fit for pickling; but their fruit afterwards was but inconsiderable.—With a little protection in severe frost, the olive-tree may be maintained against a wall, in the latitude of London; but in Devonshire there are some of these trees which have grown in the open air many years, and are seldom injured by frost, but the summers are not warm enough to bring the fruit to maturity.

THE SANDAL-TREE

The sandal is a beautiful tree; the branches are regular and tapering; the leaf resembles the narrow willow, and is delicately soft; the blossoms hang in bunches of small flowers, either red or white, according to the colour of the wood: the fruit is small, and valuable only for its seed.

It is indigenous on the rocky hills in the Onore districts, and if permitted would grow to a tolerable size; but the wood is so valuable, that the tree is cut down at an early age, and it is met with more than a foot broad: the wood is either red, yellow, or a whitish brown; and from its colour and size, is called the first, second, and third sort of sandal wood, each varying in price.

CINCHONA.

Where Andes hides his cloud-wreath'd crest in snow,
And roots his base on burning sands below;
Cinchona,* fairest of Peruvian maids,
To health's bright goddess in the breezy glades,
In Quito's temperate plate an altar read,
Thrill'd the loud hymn, the solemn prayer preferr'd.

DARWIN.

These trees are so named from the Countess del *Cinchon*, lady of a Spanish viceroy, whose cure is said first to have brought the Peruvian bark into reputation. The branches are round except at the top, where they are obscurely four-cornered; the flowing-branches are alternately compressed; and the leaves are opposite, undivided, and quite entire.

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* Several of these trees were felled for other purposes into a lake, when an epidemic fever prevailed at Loxa, in Peru, and the woodmen, accidentally drinking the water, were cured; and thus were discovered the virtues of this famous drug.

The *Cinchona officinalis*, or common *jesuits' bark*, is a tall tree, with a large trunk. The branches are covered with a purplish brown bark, frequently rugged with obliquely-transverse chinks, and scarred by the fallen leaves. It is a native of Peru, growing most abundantly on a long chain of mountains extending to the north and south of Loxa, between two and five degrees of south latitude.

The soil in which they thrive best is a red clayey or rocky ground, especially on the banks of small rivers or torrents. The proper season for cutting the bark is from September to November, which is the only time of some intermission from rain. On a spot where the trees abound, having made a road to it from the nearest plantation in the low country, huts are built for the workmen, and a large hut for the bark. Each Indian is provided with a large knife, and a bag that will hold about 50 pounds of green bark; he cuts down the bark as high as he can reach from the ground; he then fastens a stick about half a yard long, with tough withs to the tree like the step of a ladder, and having sliced off the bark as high as he can reach with this, he fixes a new step, and thus mounts to the top, another Indian below gathering up what he cuts: this they do by turns, going from tree to tree until the bag is full. Care is taken not to cut the bark wet; and, if it should happen to be so, it is carried directly to the low country to dry, for otherwise it loses its colour, turns black, and rots; and, if it lie any time in the hut without being spread, it runs the same risk, so that, if the weather permit, it remains as short a time there as possible. Whilst the Indians are cutting, the mules are employed in carrying the bark to the drying place, where it is spread in the open air, and frequently turned.

The trees are said soon to perish on being stripped of their bark, and hence a scarcity of it has been apprehended. Condamine, however, asserts, that the young trees do not die by losing their bark, but send out fresh shoots from the base; and, as the trees which attain any considerable age, probably increase by seed, the fear that this valuable bark may be exhausted seems to be groundless.

The virtues of this celebrated medicine were very little known till about the year 1638, when a signal cure having been performed by it, on the Spanish viceroy's lady, the Countess del Cinchon, at Lima, it came into general use; and hence was distinguished by the appellation of *pulvis comitissæ cortex china china*, or *chinchina*, *kina kina* or *kinkina*, *quina quina*, or *quinquina*. The countess, on her recovery, is said to have distributed a large quantity of the bark among the Jesuits, in whose hands it acquired still greater reputation, and by them it was first introduced into Europe, and thence called *jesuits' bark, cortex s. pulvis jesuiticus pulvis patrum*, and also *Cardinal de Lugo's powder ;* that charitable prelate having bought a large quantity of it at a great expence, for the use of the poor at Rome.

A new variety of the cinchona, called *yellow bark*, was discovered, and described as being superior in efficacy to the rest, by Dr. Relph, in 1794. This bark, though denominated *yellow*, is only to be understood as approaching nearer to that colour, than any other species of Peruvian bark imported into this country, especially when reduced to powder. It consists of flattish irregular pieces, of a cinnamon colour, inclining to red, and having in certain directions of the light, a peculiar sparkling appearance on the surface. They are very generally divested of the cuticle, of a fibrous texture, and easily rubbed into powder. They have little odour, but to the taste manifest intense bitterness, with a moderate share of astringency, together with a certain flavour corresponding unequivocally to those of the cinchona officinalis.

Dr. Wright informs us, that the jesuit's bark tree of Jamaica and the Caribbees rises only to twenty feet, with a trunk not thick in proportion, but hard, tough, and of yellowish-white colour in the inside. The leaves are of a rusty green, and the young buds are of a blueish-green hue. The flowers are of a dusky yellow colour, and the pods black: when ripe they split in two, and are, with their flat brown seeds, in every respect similar to those of cinchona officinalis. The bark in general is smooth and grey on the outside, though in some rough and scabrous; when well dried, the inside is of a dark-brown colour. Its flavour at first is sweet, with a mixture of the taste of horse-radish, and of the aromatics of the east; but when swallowed, of that very bitterness and astringency which characterizes the Peruvian bark. It grows near the sea-shore, and is called in Jamaica *sea-side beech*. It is a native of the West Indies and was introduced in 1780.

THE UPAS, OR POISON-TREE.

Fierce in dread silence on the blasted heath
Fell Upas sits, the hydra-tree of death.
Lo: from one root, the envenom'd soil below,
A thousand vegetative serpents grow. DARWIN.

FROM its extravagant nature, its susceptibility of poetical ornament, its alliance with the cruelties of a despotic government, and the sparkling genius of Darwin, whose purpose it answered to adopt and personify it as a malignant spirit (in his Loves of the Plants), the Upas, or poison-tree, has obtained almost equal currency with the wonders of the Lerna hydra, the Chimera, or any other of the classic fictions of antiquity.

Although the account published by Foerch, in so far as relates to the situation of the poison-tree, to its effects on the surrounding country, and to the application said to have been made of the upas on criminals in different parts of the island, as well as the description of the poisonous substance itself, and its mode of collection, has been demonstrated to be an extravagant forgery;--the existence of a tree on Java, from the sap of which a poison is prepared, equal in fatality, when thrown into the circulation, to the strongest animal poisons hitherto known, is a fact which has been both established and illustrated. The tree which produces this poison is the anchar, and grows in the eastern extremity of the island. The work of Rhumphius contains a long account of the upas, under the denomination of arbor toxicaria. The tree does not grow on Amboina, and his description was made from the information he obtained from Makasar. His figure was drawn from a branch of what is called the male-tree, sent to him from the same place, and establishes the identity of the poison-tree of Makasar, and the other Eastern Islands, with the anchar of Java. The simple sap of the arbor toxicaria (according to Rhumphius) is harmless, and requires the addition of several substances, of the affinity of ginger, to render it active and mortal. In so far it agrees with the anchar, which, in its simple state, is supposed to be inert, and, before being employed as a poison, is subjected to a preparation which will be described after the history of the tree. Besides the true poison-tree, the upas of the Eastern Isands, and the anchar of the Javans, this island produces a shrub, which, as far as observations have hitherto been made, is peculiar to the same, and, by a different mode of preparation, furnishes a poison far exceeding the upas in violence.

The anchar is one of the largest trees in the forests of Java. The stem is cylindrical, perpendicular, and rises completely naked to the height of 60, 70, or 80 feet. Near the surface of the ground it spreads obliquely, dividing into numerous broad appendages or wings, much like the canarium commune (the canary-tree), and several other large forest trees. It is covered with a whitish bark, slightly bursting in longitudinal furrows. Near the ground this bark is, in old trees, more than half an inch thick, and, upon being wounded, yields plentifully the milky juice from which the celebrated poison is prepared. A puncture or incision being made into the tree, the juice or sap appears oozing out, of a yellowish colour (somewhat frothy) from old, paler or nearly white from young ones; exposed to the air, its surface becomes brown. The consistence very much resembles milk; it is more thick and viscid. This sap is contained in the true bark (or cortex), which, when punctured, yields a considerable quantity, so that in a short time a cup-full may be collected from a large tree. The inner bark (or liber) is of a close fibrous texture, like that of the *morus papyrifera*, and, when separated from the other bark, and cleansed from the adhering particles, resembles a coarse piece of linen. It is often worked into ropes, which are very strong; and the poorer classes of people employ the inner bark of the younger trees, which is more easily prepared, for the purpose of making a coarse stuff which they wear in working the fields. It appears from the account of the manner in which the poison is prepared, that the deleterious quality exists in the gum; a small portion of which still adhering, produces, when exposed to wet, this irritating effect: and it is singular that this property of the prepared bark is known to the Javans in all places where the tree grows, while the preparation of a poison from its juice, which produces a mortal effect when introduced into the body by pointed weapons, is an exclusive art of the inhabitants of the eastern extremity of the island.

THE TEAK-TREE.

Of the teak-tree there is but one species known, the tectona grandis of Linnæus, the tekka of Van Rheede, and the jatus of Rhumphius. The varieties are usually distinguished, among the natives of Java, by the names derived from the quality and colour of the wood.* The principal are, the *játi cápua*, the chalky teak, and a kind varying in colour, and on account of its excellence termed *játi súng'gu*, or the true teak. The former is the most common: its wood is of a whitish hue, and it sometimes contains calcareous concretions in nodules or streaks. This sort is chiefly employed for common domestic purposes, and, though inferior in quality to many others, from its abundance and comparative cheapness, is perhaps the most generally useful. The *játi súng'gu* is harder, closer, and more ponderous, and particularly well calculated for ship-building. The colour of the wood is of different shades, from light to intense brown, with a cast of violet verging sometimes to red or black. If the stem is covered with spines, or rather pointed scales, it is called *játi dúri*, but in its texture and quality it agrees with the *játi súng'gu*. Besides these the natives distinguish, as *játi gémbol*, those excrescenses or protuberances which are produced from a variety of the *játi*, furnishing materials for handsome cabinet-work. Under favourable circumstances, a growth of them from twenty to twenty-five years affords a tree having about twelve inches diameter at the base. It requires at least a century to attain its perfection; but, for common purposes, it is usually felled when between thirty and fifty years old.

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* Among the other useful trees in Java must be noticed—the soap-tree, of which the fruit is used to a very great extent in washing linen:—the *kasémak*, from the bark of which is made a varnish

THE STORAX-TREE

Rises twenty feet, and sends off many strong branches, covered with a roughish grey bark; the leaves are broad, elliptical, entire, somewhat pointed, and the upper surface smooth, and a light green; the under surface is covered with a whitish down; the flowers are white, and disposed in clusters upon short peduncles, which terminate the branches: the corolla is monopetalous, funnel-shaped, and divided at the limb into five lance-shaped segments: the ten filaments, in a regular circle, adhere towards the base: the antheræ are erect and oblong; the germen is oval, and supports

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for umbrellas:—the *sámpang*, from the resin of which the natives prepare a shining varnish for the wooden sheaths of krîsis:—the *bendûd*, a shrub producing the substance of which the elastic gum, commonly called Indian rubber, is prepared. The *mínyak káwon*, or *niátu*, is a very useful tree, which grows solitary in all, and abundantly in some parts of the island, and produces a kind of tallow.

a slender style, with simple stigma: and the fruit is a pulpy pericarpium, containing one or two oval compressed nuts.

The *storax benzoin* has oblong accuminated leaves, downy underneath, and nearly of the length of the racemi.

This tree, a native of Sumatra, is deemed in six years, or when its trunk acquires about seven or eight inches in diameter, of sufficient age for affording the benzoin: the bark is then cut through longitudinally, or obliquely, at the origin of the principal lower branches, from which the drug exudes in a liquid state, and by exposure to the sun and air soon concretes, when it is scraped off with a knife or chisel. The quantity of benzoin which one tree affords, never exceeds three pounds; nor do the trees sustain the effects of these annual incisions longer than ten or twelve years. The benzoin which issues first in the purest, being soft, extremely fragrant, and very white; that less esteemed is brownish, very hard, and mixed with various impurities, acquired during its long continuance upon the trees.

Liquid storax is a resinous juice obtained from a tree called *liquidambar styraciflua*, a native of Virginia and Mexico, and lately naturalized in this country. The liquidambar exudes from incisions in the trunk, and the liquid storax is obtained by boiling the bark or branches in water.

The *elemifera*, which bears the gum elemi, a native of South America, grows six feet high, producing trifoliated stiff shining leaves, growing opposite on footstalks two inches long. At the ends of the branches grow four or five slender stalks, set with many very small white flowers. The *Gileadensis*, or opobalsamum, an evergreen shrub, grows spontaneously in Arabia Felix, producing the opobalsam, or balm of Gilead. The *toxifera*, or poison-wood, a small tree, with a smooth light-coloured bark, grows usually on rocks, in the Bahama islands. The *balsamifera*, or rose-wood, is found on gravelly hills in Jamaica and the other West India islands; it rises very high, and the trunks are remarkable for large protuberances. The leaves are laurel-shaped; the flowers blue, small, on a branched spike; and the berries are small and black.

The first species, called in the Brasils *icicariba*, furnishes the resin *gum elemi*, or gum lemon, brought from the Spanish West Indies, and sometimes from the East Indies, in roundish cakes, wrapped up in flag leaves. It gives name to an officinal ointment, but is not otherwise used in medicine. The second species yields the balsam of Mecca, of Syria, or of Gilead, the most fragrant and pleasant of balsams. The true balsam-tree is found near Mecca, about a day's journey from the Red Sea, on the Asiatic side. It has a yellowish, or greenish-yellow colour, a warm bitterish aromatic taste, and an acidulous fragrant smell. It is held in great esteem, and recommended in various complaints; but the Canada and copaiva balsams are now generally believed to have equal efficacy. The rose-wood affords an excellent timber, of great use to cabinet-makers. It is replete with a fragrant balsam or oil, which it long retains; and, by distillation, the wood yields a perfume nearly equal to the oil of the rhodium pine.

The *Catechu* grows twelve feet high, and one foot in diameter; covered with a thick rough brown bark, and towards the top divides into many close branches; the leaves are doubly winged, and alternate upon the younger branches. From this tree, which grows plentifully on the mountainous parts of Indostan, where it flowers in June, is produced the officinal drug long known in Europe by the name of *terra japonica.*

The *Nilotica*, or true Egyptian acacia, rises to twenty feet; the bark of the trunk is grey and smooth, that of the branches purple; the leaves bipinnated, and alternate.

Though the mimosa nilotica grows in abundance over the vast extent of Africa, yet gum arabic is produced chiefly by those trees situated near the equator; and in Lower Egypt the solar heat is never sufficiently intense for this purpose. The gum exudes in a liquid state from the bark of the trunk and branches, (similar to the gum often produced upon cherry and plum trees in this country;) and by exposure to the air it soon acquires solidity and hardness. In Senegal, when the tree first opens its flowers, the gum begins to flow, and continues during the rainy season till December, when it is first collected. Another collection is made in March, from incisions in the bark, which the extreme dryness of the air renders necessary.

THE CASHEW-NUT TREE.

The only species yet known, the *occidentale*, grows naturally in the West Indies, twenty feet high, and is preserved in Britain with the greatest difficulty. The fruit is as large as an orange, full of an acid juice, frequently used in making punch. To its apex grows a nut, like a hare's kidney, largest at the end next the fruit. The shell is very hard, and the kernel is sweet and pleasant, and covered with a thin film. Between the two layers, or tables, which compose the shell, is lodged a dark inflammable oil, so caustic in the fresh nut, that if the lips touch it, blisters immediately follow.

This caustic oil is employed in the West Indies, by young ladies, to renovate their complexions; they suffer some pain in its application, and submit to nearly a fortnight's confinement; after which their new skin looks as fair as that of a new-born child.

This plant is easily raised from the nuts, each planted in a separate pot of light sandy earth, and plunged into a good hot-bed, and kept from moisture till the plants come up. If the nuts are fresh, the plants will come up in a month; and in two months more, will be four or five inches high, with large leaves.

THE BUTTER-TREE

Is of a moderate size, with long alternate leaves, and produces a fruit about the size of a walnut, and of an aromatic smell. Within the fruit is a stone containing a kernel the size of an acorn. According to Mungo Park, the celebrated traveller, it ranks among the first of African vegetables in point of utility. When Park reached a certain district in the interior of Africa, he found the people busily employed in collecting the fruit of the shea trees, from which they prepare the vegetable butter. These trees grow in great abundance in the part of Bambara, through which he was then travelling. "The tree itself," says he, "resembles the American oak; and the fruit, (from the kernel of which, being first dried in the sun, the butter is prepared by boiling the kernel in water,) has somewhat the appearance of a Spanish olive. The kernel is enveloped in a sweet pulp, under a thin green rind; and the butter produced from it, besides the advantage of its keeping the whole year without salt, is whiter, firmer, and to my palate, of a richer flavour than the best butter I ever tasted made from cows' milk."

THE BETEL-TREE

Is a species of palm, well known in India for the constant use of its nut. It is remarkably tall, straight, and slender, is crowned with six or eight leaves, each about six feet long, and winged, or composed of two ranges of straight lanceolate leaflets, placed opposite to each other. The side of the common leaf stalk is angular; and it expands at its base into a tough sheath, which encompasses the trunk of the tree, and is of so strong and close a texture, that the natives use it to hold their victuals, and to contain their arrack, which it does as effectually as a bladder. The nuts grow in clusters at the top of the tree, like those of the cocoa; but are not larger than a hen's egg: between their outward bark and the stone is contained a succulent and fibrous pulp, which the natives call *pinangue*, and which they mix occasionally with their betel. The mastication of betel is in general use in India, where it is introduced both morning and evening. Another species, the *Areca loveacea*, inhabiting the Antilles, is of considerable service to the natives, on account of its durable wood. —The Americans use the trunks for water-pipes and gutters, and when split into planks they serve to inclose the negro huts and gardens. There is a terminal bud growing from the centre of this tree, which is composed of the young leaves, and considered as a delicacy by the natives, who say that it tastes like an artichoke. It is either eaten raw with pepper, dressed with a white sauce, or fried.

THE MANGROVE.

THIS singular tree is a native of the East Indies and Africa, where it grows to the height of ten or twelve feet, and is always found in moist and marshy places, generally within the influence of the sea, and where the tide can readily wash its stem. The mangrove is divided into a vast number of branches, which extend on all sides, and are thickly covered with oval shining leaves, about five or six inches long. The trunk and the lower branches send out several round flexible shoots, which descend to the ground, and there take root. These shoots, in time, become so interlaced, as to produce an almost impenetrable grove, somewhat resembling the banyan-tree, but much thicker. In consequence of the mangrove-trees growing as it were in the water, they become the retreat of fishes, and especially of oysters. These last deposit their spat upon the stems and branches, which in time become loaded with them; and the oysters gathered from such situations may be readily known by pieces of the wood which are generally attached to the shells.

THE CORK.

The various uses to which the bark of this tree is applied, are too well known to need enumerating. The acorns, which have a sweetish taste, not only serve to feed hogs and poultry, but are likewise useful to mankind; who, in the time of scarcity, have availed themselves of their aid. It is said that the Spaniards eat them like roasted chesnuts.

When the trees have attained the age of twelve or fifteen years, they remove the bark for the first time; but the cork at this barking is only fit to burn. Seven or eight years after it is again removed, but yet it is far from being of a good quality, and is only used for common purposes. This operation is repeated when the trees are about thirty years old, and then the bark is found to be of a superior nature, and fit for the purposes to which the cork is applied. The best bark is obtained from the oldest trees, and the removal of this substance is far from proving injurious to the plant, since a cork-tree which is barked every eight, nine, or ten years, will live for a century and a-half, and somesimes longer.

In July and August the persons employed upon the cork-trees begin their operations. The chief instrument that they use for the purpose of raising the bark, is a small hatchet, with a handle terminating in a wedge. With this instrument they slit the bark from the top of the tree to the bottom, and then make a circular incision at the two ends of the slit; after this is done the bark is well beaten with the back of the hatchet, in order to loosen it from the tree; and it is then raised by introducing under it the wedge-shaped handle, till the whole piece is detached from the wood.

The cork is cut into pieces of four or five feet in length, and afterwards scraped, to render its surface even. The pieces are then placed over burning coals, in order to blacken them; and it is said that this operation at the same time closes the pores, and improves the quality of the cork.

THE BAMBOO.

Of all the plants that belong to the family of grasses, the bamboo is the only one that rises to the height of a tree, with a stem of proportionate thickness. Thi height varies according to the soil and situation. The bamboo, which is common over all India, and which is of so much service to the inhabitants, is the largest of all the varieties of this plant. It grows to the height of eighty feet, and measures from twelve to eighteen inches in diameter. With this they make their chests, their small boxes, and the measures for rice. They propagate the plant by suckers of two or three joints, which they place obliquely in the ground. The wood of this species, as well as of its several varieties, although extremely light, is very strong: with the thickest they make their enclosure walls and partitions, while those of a middle size serve as levers to carry palanquins and other burthens. The Indian wine-dressers, who are employed to collect the palm-wine, make bridges of bamboo from one tree to another, so that they may pass and collect the juice without descending to the ground. The Chinese boil the roots to the consistence of thick milk, and with this preparation they make a kind of paper used by their draftsmen, and sometimes to cover their parasols.

The *Bamboo Tebor* is remarkable for the thickness of its stem, which is eighteen inches in diameter, and set with strong spines. The superior articulations, which are open, serve the inhabitants as measures for their liquors, while the lower joints are used for stakes; of which the Macassars form a kind of rampart.

THE SYRINGE.

WHICH is well known for the valuable elastic resin which is produced from it, grows in the Brazils and in Guinea. It is described as very straight and tall, and as growing to the height of fifty or sixty feet. A considerable number of these trees has been found in the forests of South America, to the north of Quito, where the natives call them *heve.* When the tree is wounded there exudes from the incision a white liquid, like milk, which gradually hardens in the air; of this the inhabitants make the flambeaux, which burn well without a wick for the space of twelve hours. On the banks of the Amazon, where the tree is not uncommon, the natives form the resin into rude figures of fruit, birds, &c. They likewise make their boots of it, which, being water-proof, are highly serviceable to the inhabitants of a country where the plains are intersected with rivulets.

THE PAPYRUS.

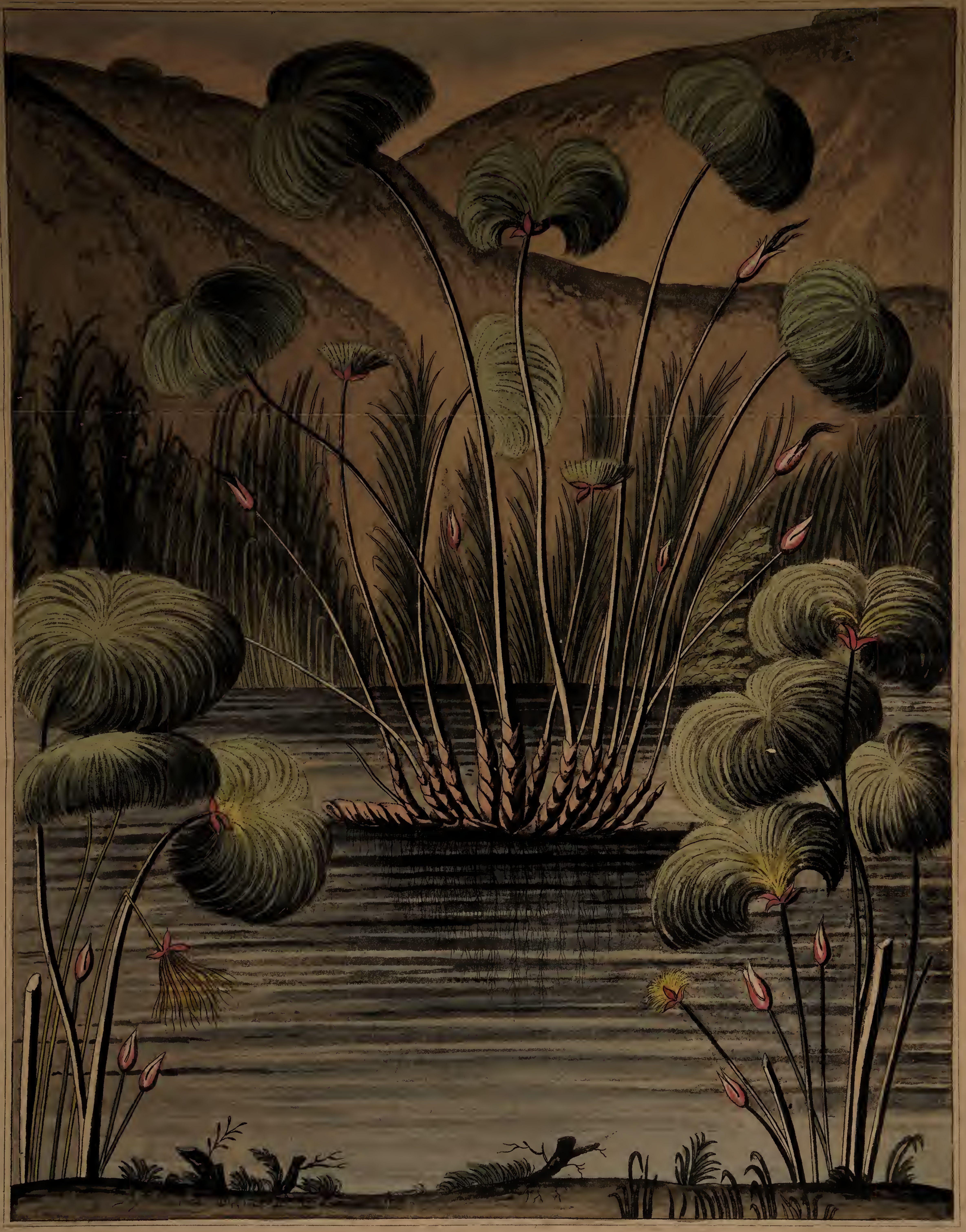
Papyra, thron'd upon the banks of Nile,
Spread her smooth leaf, and wav'd her silver style.
The stoned pyramid, the laurel'd bust,
The trophy'd arch had crumbled into dust;
The sacred symbol and the epic song,
(Unknown the character, forgot the tongue,)
With each unconquer'd chief, or sainted maid,
Sunk undistinguish'd in Oblivion's shade.
Sad o'er the scatter'd ruins Genius sigh'd,
And infant Arts but learn'd to lisp—and died.
Till, to astonish'd realms, PAPYRA taught
To paint in rustic colours sound and thought;
With Wisdom's voice to print the page sublime,
And mark in adamant the steps of time. DARWIN.

THE leaf of this plant was first used for paper, whence the word *paper;* and leaf, or *folium*, for the fold of a book. Afterwards the bark of a species of mulberry was used; whence *liber* signifies a book, and the bark of a tree.

The Egyptians applied the papyrus to several purposes independent of the manufactory of paper. The roots sometimes served them for firewood, and were frequently formed into domestic utensils. Of the stems interlaced together, they formed a kind of boat; and of the interior bark they made their sails, mats, their clothes, their cordage, and the coverlets of their beds. The inhabitants on the borders of the Nile eat the lower and succulent parts of the stem of the papyrus, after having baked it to make it more palatable.

Before the invention of letters, mankind may be said to have been perpetually in their infancy, as the arts of one age or country generally died with their inventors. After the discovery of letters, the facts of astronomy, medicine, and chemistry became recorded in written language. Probably, the first materials were stones and hard substances, and the mechanism of writing by coloured liquids was a subsequent invention. The large leaf of the papyrus afforded the first material, as it grew in great abundance in the inlets of the Nile; but as it would not fold, the leaves were stitched together, and rolled on a piece of wood.

The head of this plant is composed of a number of small grassy filaments, each about a foot long. About the middle each of these filaments parts into four; and in the point or partition, are four branches of flowers; the head of this is not unlike an ear of wheat in form; but which in fact is a chaffy, silky, soft husk. These heads, or flowers, grow upon the stalk alternately, and



THE PAPYRUS.

are not opposite to, or on the same line with, each other at the bottom.

In Theophrastus, lib. 4, *De Plantis*, the Papyrus is described as one of the three Ægyptian plants, which, (he says) amongst an infinite number of others of that kind, in the same country, are the sweetest and the most nutritive. "The papyrus grows about two cubits, and sometimes less, in water. The thickness of its root is equal to the wrist of a stout man, and its height more than ten cubits. They use not only the fibres for fuel, but also make utensils of every species, and of good appearance. In truth, the papyrus is serviceable for very many things, as they form out of it vessels for navigation; besides that, from its rind they form not only sails, but mats, and certain dresses, and coverings, and even ropes, and many other things, and books. It yields also a considerable supply of nutriment, for every one in the country chews the papyrus, as well in a raw, as in a boiled and roasted state."

Besides the papyrus plant, there are other species of plants which are now manufactured into paper. Dr. Wallich has produced samples of paper made of the bark of the paper-shrub, a species of *Daphne*, and probably the same that is described by Father Louriero in his Flora of Cochin-China. The paper manufactured from this substance is extremely cheap and durable. It is said to be particularly calculated for cartridges, being strong, tough, not liable to crack or break, however much bent or folded, proof against being moth-eaten, and not in the least subject to dampness from any change in the weather. If kept in water for any considerable time, it will not rot, and is invariably used all over Kemaoon, and in great request in many parts of the plains, for the purpose of writing genealogical records, deeds, &c. The method of preparing the paper is extremely simple. The external surface of the bark being scraped off, that which remains is boiled in clean water, with a small quantity of the ashes of the oak, which whitens the material. It is then washed, beat to a pulp, and, after being mixed up with the fairest water, is spread on moulds of frames made of common bamboo mats. Besides these, is the *Bhojputtra* of the natives, being the outer rind of a new species of birch. It is much used in the mountainous countries to the north for writing upon, particularly by the religious.

THE TALLOW-TREE

GROWS on the banks of rivulets in China. It generally arrives at about the height of a pear-tree, resembles the cherry in its trunk and branches, and the black poplar in its foliage: there is this difference, however, in the wax-tree; its leaves, which are of a bright red colour, are not toothed, and have two small glandules seated at the base of each. The fruit is contained in a husk divided into three spherical segments, which open when it is ripe, and discover three white grains, of the size of a small walnut.

The Tallow-tree is cultivated in several European colonies of both Indies, as well as in the southern parts of Europe. Besides the tallow which the Chinese obtain from this plant, they express a considerable quantity of oil from its seeds, which is principally used in their lamps.

RICE.

THIS nutritious substance, which may be denominated the farinaceous grain of oriental and tropical countries, and which is cultivated to an extent which is altogether incalculable, forms an article so extensively useful and so teeming with its many good qualities to the millions of human beings whom it supports, as to acquire, in those populous regions where its excellence is best appreciated, the emphatic appellation of the staple of food.

It is divided into two sorts, viz. that which grows upon high land, and the one which fructifies upon the low ground, and which sorts are always kept separate, and will not grow reciprocally. Of these, the former bears the highest value, being whiter, heavier, and better flavoured, and possessing the advantage of keeping better; the latter is much more prolific from the seed, but is of a watery substance, and produces less increase in boiling, and is subject to a swifter decay; it is, however, in more general consumption than the other; besides, this first species presents a variety of kinds, viz. the common dry ground-rice, which is of a light brown colour, and of a rather large size, and slightly crooked at the extremity. The second sort possesses a short round grain, which grows in bunches round the stock.

The third is distinguishable by a large grain. The fourth is of deep coloured varieties, and a fine yellow rice. Fifth, the finest sort grows in wet ground, and is in its form small, straight, and light-coloured. As a brief description, it may be observed that the largest grained rice is the least esteemed for goodness, and the smaller and whitest grain holds a deserved preference for quality.

THE CAMPHOR TREE OF SUMATRA.

THE Camphor Trees are the monarchs of the forests of Sumatra, being often a hundred feet perpendicular to the first branch; and they are as straight as masts.—The camphor is found in concrete masses, in cracks and hollows in the heart of the tree. Very little of it finds its way to Europe; it goes chiefly to China, where it bears a price about thirty times that of the China camphor, which is the article we use in Europe. The latter is the produce of the *laurus camphora*, obtained by boiling; the former an imperfectly known genus, called *pyrobalanops*, and is the natural product of the tree. It is not exactly known what occasions its enormous value in China, 3,000 dollars a pecul of 133lbs. It has been supposed that it was mixed with their own camphor, and sold again in that adulterated state; but the difference of price renders this improbable. It is suspected that the Chinese, whose epicurism is very extraordinary and different from ours, use it in some way or other for culinary purposes. Besides the camphor, the tree yields an oil which is very powerful. It only flowers once in four or five years.

The *Rattle-snake Wort* grows in many parts of North-America. The Indians are well acquainted with the virtues of the root; and when they have the misfortune to be bitten by the rattle-snake, with which the woods abound, they swallow a small quantity of the juice, and rub a portion on the wound. This simple remedy is always considered as a specific. Its efficacy in the pleurisy has been well established in Virginia: formerly, nearly fifty out of a hundred died of that disorder; but, by the happy use of the *polygala*, hardly three out of the same number have been lost.

The *Stapelai* is a genus of plants found in the interior of Africa; from its wonderful facility for retaining water, amidst the severest droughts, has been termed the camel of the vegetable world, as it occasionally imbibes large quantities of fluid, and retains them to supply the deficiencies of dryer seasons.

The *Nepenthes Distillatoria*, or pitcher-plant, indigenous in the island of Java, is found on the most stony and arid situations, where it must wither and perish, but for the provident economy of nature. Mr. Barrow thus describes it: "At the foot-stalk of each leaf, and near the base, is attached a small bag, shaped like a pitcher, of the same consistence and colour as the leaf is in the early stage of its growth, but changing with age to a reddish purple. It is girt round with a lid, neatly fitted, and moveable on a kind of hinge or strong fibre, which, passing over the handle of the pitcher, connects the vessel with the leaf. By the contraction of this fibre, the lid is drawn up whenever the weather is showery or dew falls, which appears to be exactly contrary to what generally happens in nature; though the contraction is occasioned, probably, by the hot and dry atmosphere, and the expansion of the fibres does not take place until the moisture has fallen and saturated the pitcher: when this is the case, the cover falls down, and closes so firmly as to prevent any evaporation. The water being gradually absorbed through the handle into the foot-stalk, gives vigour to the leaf, and substance to the plant. As soon as the pitchers are exhausted the lids again open, to admit any moisture that may fall; and when the plant has produced seed, and the dry season fairly sets in, it withers, with all the covers of the pitchers standing open."

The *Gourd*, or *Pumpkin*, cultivated in this country only for curiosity; but in both Indies, bottle-gourds are cultivated and sold in the markets. The Arabians call this gourd *charrah*. It grows commonly on the mountains in the deserts. The natives boil and season it with vinegar; and sometimes, filling the shell with rice and meat, make it into a pudding. The large shell is used to hold water, and some will contain twenty gallons. The fruit of the pompion constitutes much of the food of the common people, during the hot months, in those places where they grow.

The *Cypress of Louisiana* grows with its roots in water, and is principally found on the banks of the Mississippi, whose shores are shaded with its magnificent foliage. The circumference of the trunk is nearly thirty feet; and, to enable it to resist the floating masses of ice, which, at the breaking up of the wintry season, come down in great quantities from the northern lakes, several large protuberances act as buttresses, evidently designed to protect the base; whilst upwards, at the height of six feet, the trunk is sensibly diminished. The heads are round and smooth; neither leaves nor branches, and, therefore, cannot be considered as shoots. They are, in fact, ice-breakers.

The *Jalap*, famous for its use in medicine, is a native of Aleppo, in Spanish America, between Vera Cruz and Mexico. It has a large oval root, full of a milky juice; from which many herbaceous twining stalks rise eight or ten feet high, garnished with variable leaves; some being heart-shaped, others angular, and some oblong and pointed; smooth, and upon long footstalks; the flowers are shaped like those of the common greater bind-weed, each footstalk supporting only one flower.

The *Polypodium*, or Tartarian Lamb, is a native of China, with a decumbent root, thick, and every where covered with the most soft and dense wool intensely yellow. This curious stem is sometimes pushed out of the ground in its horizontal situation by some of the inferior branches of the root, so as to give it some resemblance to a lamb standing on four legs, and has been said to destroy all other plants in its vicinity.—Sir Hans Sloane describes it under the name of Tartarian Lamb, and Dr. Hunter, in his edition of the Terra of Evelyn, has given a more curious print of it, much resembling a sheep. The down is used in India externally, for stopping hemorrhages, and is called golden moss.

LECTURE LXXXI.

ON THE SENSITIVE AND CHEMICAL POWERS OF PLANTS, WITH EXAMPLES.

On these curious points we have reserved a special lecture, because they merit special consideration, and the most remarkable flourish in both zones; and, therefore, could not be included in the special classifications. These phenomena are confined entirely to the leaves, and arise from some mechanical or atomic affection of their muscles; but, whatever be the cause, the sensibility of the leaves of many plants is among the interesting phenomena of Nature.

These powers are interesting in all their relations, whether considered as forming a link between the two animated kingdoms, or as explanatory of all the apparent actions of the plant. Leaves, particularly those that are compound, exhibit these phenomena in a very singular degree; sometimes in the regular course of nature, and sometimes when placed in novel situations for the purposes of experiment.

Many leaves, as those of the mallow, follow the course of the sun. In the morning, their superior surfaces are presented to the east; at noon, they regard the south; and, when the sun sets, they are directed to the west. During the night, or in rainy weather, these leaves are horizontal; and their inferior surfaces are turned toward the earth. The helianthus, or sun-flower, also, follows the course of the sun:

> Great Helianthus guides, o'er twilight plains,
> In great solemnity his dervise trains:
> Marshalled in *fives*, each gaudy band proceeds,
> Each gaudy band a *plumed* lady leads;
> With zealous steps he climbs the upward lawn,
> And bows in homage to the rising dawn;
> Imbibes with eagle-eye the golden ray,
> And watches, as it moves, the orb of day.

What has been denominated the *sleep of plants*, affords an instance of another phenomenon of vegetable motion. The leaves of many plants fold up during the night; but, at the approach of the sun, they expand with new vigour. The common appearances of most vegetables are so changed in the night, that it is difficult to recognise the different kinds, even by the assistance of light.

The modes of folding in the leaves, or of sleeping, are extremely various. But it is worthy of remark, that they all dispose themselves so as to give the best protection to the young stems, flowers, buds, or fruit.

The leaves of the tamarind-tree contract round the tender fruit, and protect it from the nocturnal cold. The cassia or senna, the glycine, and many of the papilionaceous plants, contract their leaves in a similar manner. The leaves of chickweed, of the asclepias, atriplex, &c. are disposed in opposite pairs: during the night, they rise perpendicularly, and join so close at the top, that they conceal the flowers. The leaves of the sida or althæa theophrasti, of the ayenia, and œnothera, are placed alternately: though horizontal, or even depending, during the day, at the approach of night they rise, embrace the stem, and protect the tender flowers. The leaves of the solanum, or night-shade, are horizontal during the day; but in the night, they rise and cover the flowers. The Egyptian vetch erects its leaves during the night, in such a manner, that each pair seems to be one leaf only. The leaves of the white lupine, in the state of sleep, hang down, and protect the young buds from being injured by the nocturnal air.

These and similar motions are not peculiar to the *leaves* of plants. The *flowers* have also the power of moving. During the night, many of them are inclosed in their calixes. Some flowers, as those of the German spurge, geranium striatum, and common whitlow-grass, when asleep, hang their mouths toward the earth, to prevent the noxious effects of rain or dew.

Linne his enumerated forty-six flowers, which possess this kind of sensibility: he divides them into three classes. (1) *Meteoric flowers*, which less accurately observe the hour of folding, but are expanded sooner or later according to the cloudiness, moisture, or pressure of the atmosphere. (2) *Tropical flowers*, that open in the morning and close before evening every day; but the hour of their expanding becomes earlier or later as the length of the day increases or decreases. (3) *Equinoctial flowers*, which open at a certain and exact hour of the day, and for the most part close at another determinate hour.

In every copse, and sheltered dell,
Unveiled to the observant eye,
Are faithful monitors, who tell
How pass the hours and seasons by.

The green robed children of the spring
Will mark the periods as they pass,
Mingled with leaves time's feathered wing,
And bind with flowers his silent glass.

Mark where transparent waters glide,
Soft flowing o'er their tranquil bed;
There cradled on the dimpling tide,
Nymphæa rests her lovely head.

But conscious of the earliest beam,
She rises from her humid nest,
And sees reflected in the stream
The virgin whiteness of her breast.

Till the bright day-star to the west
Declines, in Ocean's surge to lave,
Then, folded in her modest vest,
She slumbers on the rocking wave.

See *Hieracium's* various tribe,
Of plumy seed and radiate flowers,
The course of time their blooms describe,
And wake or sleep appointed hours.

Broad o'er its imbricated cup
The *Goatsbeard* spreads its golden rays,
But shuts its cautious petals up,
Retreating from the noon-tide blaze:

Pale as a pensive cloistered nun
The *Bethlem star* her face unveils,
When o'er the mountain peer the Sun,
But shades it from the vesper gales.

Among the loose and arid sands
The humble *Arenaria* creeps;
Slowly the *purple star* expands,
But soon within its calyx sleeps.

And those small bells so lightly rayed
With young Aurora's rosy hue,
Are to the noon-tide Sun displayed,
But shut their plaits against the dew.

On upland slopes the shepherds mark
The hour, when, as the dial true,
Cichorium to the towering lark
Lifts her soft eyes serenely blue.

And thou, "Wee crimson tipped flower,"
Gatherest thy fringed mantle round
Thy bosom, at the closing hour,
When nightdrops cathe the turfy ground.

Unlike *Silene*, who declines
  The garish noontide's blazing light;
But when the evening crescent shines
  Gives all her sweetness to the night.

Thus in each flower and simple bell,
  That in our path untrodden lie,
Are sweet remembrancers who tell
  How fast their winged moments fly.

CHARLOTTE SMITH.

The cause of those movements which constitute the sleep of plants, has been ascribed to the sun's rays. In some instances, the motions produced are evidently excited by heat. But plants kept in a hot-house, where an equal degree of heat is preserved both day and night, fail not to contract their leaves, or to sleep, in the same manner as when they are exposed to the open air. This fact evinces, that the sleep of plants is rather owing to a peculiar law, than to a quicker or slower motion of their juices.

Some plants flower only in the night, and then only they emit their fragrance. The cactus grandiflorus, or night-blowing cereus, which is a native of Jamaica and Vera Cruz, expands a very exquisitely beautiful corol, and emits a very fragrant odour, for a few hours in the night, and then closes to open no more. The flower is nearly a foot in diameter, the inside of the calyx of a splendid yellow, and the numerous petals of a pure white. It begins to open about seven or eight in the evening, and closes before sunrise. Of its appearance in its native climes, our botanical poet thus sings, in a beautiful apostrophe:

Nymph! not for thee the radiant day returns,
Nymph! not for thee the golden solstice burns,
Refulgent Cerea! At the dusky hour
She seeks, with pensive step, the mountain bower,
Bright as the blush of rising morn, and warms
The dull cold eye of midnight with her charms,
Then to the skies she lifts her pencilled brows,
Opes her fair lips, and breathes her virgin vows;
Eyes the white zenith; counts the suns, that roll
Their distant fires, and blaze around the pole;
Or marks where Jove directs his glittering car
O'er heaven's blue vault—Herself a brighter star.
There, as soft Zephyrs sweep with pausing airs,
Thy snowy neck, and part thy shadowy hairs,
Sweet Maid of Night! to Cynthia's sober beams
Glows thy warm cheek, thy polished bosom gleams.
In crowds around thee gaze th' admiring swains,
And guard in silence the enchanted plains;
Drop the still tear, or breathe th' impassioned sigh,
And drink inebriate rapture from thine eye.

The nyctantheus, or Arabian jasmine, is another flower which expands a beautiful corol, and emits a very delicate perfume during the night, and not in the day, in its native country, whence its name. Botanical philosophers have not yet explained this wonderful property; perhaps the plant sleeps during the day as some animals do, and its odoriferous glands emit their fragrance only during the expansion of the petals; that is, during its waking hours. The geranium tribe has the same property of emitting its fragrance during the night only. The flowers of the cucurbita lagenaria are said to close when the sun shines upon them. In our climate, many flowers, as tragopogon and hibiscus, close their flowers before the hottest part of the day comes on; and the flowers of some species of cuculalus and silene, viscous campion, are closed all day; but when the sun leaves them, they expand, and emit a very agreeable scent. On this account, such flowers are called *noctiflori*.

We shall next proceed to detail some of the most interesting species of the SENSITIVE TRIBE:

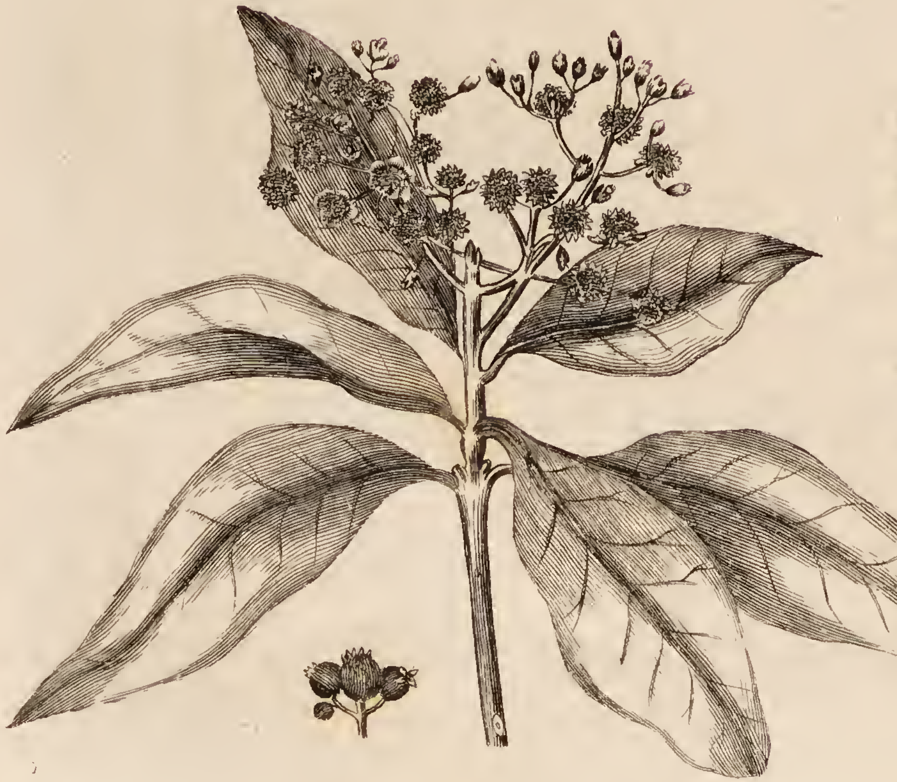
Weak with nice sense, the chaste Mimosa stands,
From each rude touch withdraws her timid hands;
Oft as light clouds o'erpass the summer-glade,
Alarmed she trembles at the moving shade;
And feels alive through all her tender form,
The whispered murmurs of the gathering storm;
Shuts her sweet eyelids to approaching night,
And hails with freshened charms the rising light.
Veiled, with gay decency and modest pride;
Slow to the mosque she moves, an eastern bride;
There her soft vows unceasing love record,
Queen of the bright seraglio of her lord,
So sinks or rises, with the changeful hour,
The liquid silver in its glassy tower;
So turns the needle to the pole it loves,
With fine librations quivering as it moves.

The *Pudica*, or Bashful Humble Plant, rises with an undershrubby, declinated, prickly stem, branching two or three feet around, armed with hairy spines; pinnated, digitated leaves, each of five or more long solioles, attached by their base to a long footstalk, and spread out above like the fingers of a hand; and at the sides and ends of the branches roundish heads of greenish white flowers, succeeded by small jointed prickly pods.

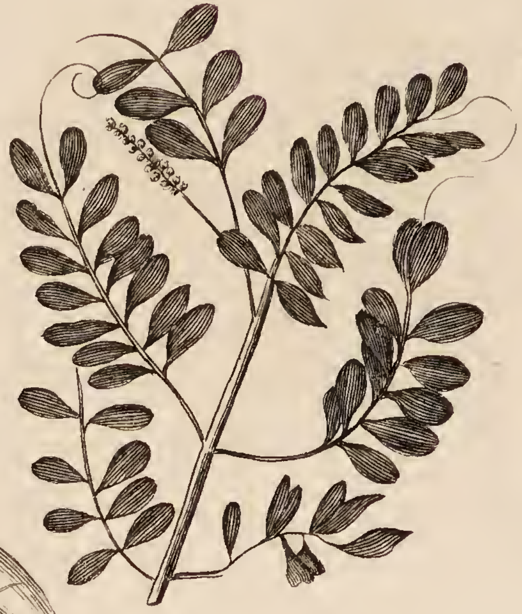
This is truly of the humble sensitive kind; for on the least touch, the leaves instantly recede, contract, close, and with the footstalk, quickly decline downward, as if ashamed at the approach of the hand.

The *Pernambucana*, or Pernambuca Slothful Mimosa, has undershrubby, procumbent, unarmed stems,

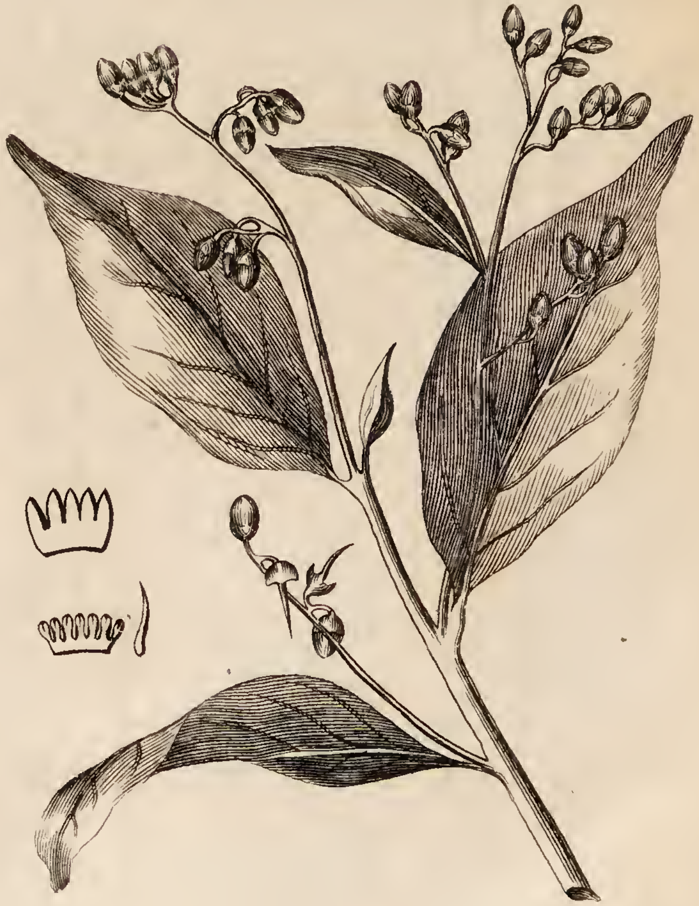
Myrtle



Sensitive Plant



Benzoin



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Neele & Son, 352 Strand

branching two or three feet around; bipinnated leaves, of three or four pair of short, winged foliola.

This species recedes very slowly from the touch, contracting only its pinnæ a little when smartly touched; hence the name slothful mimosa.

The *Asperata*, or Panama Sensitive Plant, grows in moist places, and by the sides of rivulets, in Jamaica.

The *Viva*, Lively Mimosa, or Smallest Sensitive Weed, has many creeping roots, and spreads itself so as to cover large spots of ground.

By running a stick over the plant, a person may write his name, and it will remain visible for ten minutes.

The *Scandens*, Cacoons, or Mafootoo Wyth, is frequent in all the upland valleys and woodlands in the north of Jamaica. It climbs the tallest trees, and spreads itself in every direction by its *cirrhi* or claspers, so as to form a complete arbour, and to cover the space of an English acre from one root. This circumstance has had a deleterious effect on the trees or bushes so shaded. Light, air, and rain, so necessary for all plants, being shut out, the leaves drop off, the tree gradually rots, and the leaves fall down by the weight of this parasite.

It is difficult to touch the leaf of a healthy sensitive plant so delicately that it will not immediately collapse; the foliola or little leaves moving at their base till they come into contact, and then applying themselves close together. If the leaf be touched with a little force, the opposite leaf will exhibit the same appearance; a little more force, the partial footstalks bend down towards the common footstalk whence they issue, making a more acute angle. If the touch be stronger all the leaves on the same side with that touched will instantly collapse, and the partial footstalk will approach the common footstalk same as the partial footstalk of the leaf approaches the stem or branch whence it issues; and the whole plant, from having its branches extended, will immediately appear like a weeping birch.

These motions are performed by three distinct and sensible articulations; of the foliola or lobes to the partial footstalk; of the partial footstalk to the common one; of the common footstalk to the trunk. The primary motion is the closing of the leaf upon the partial footstalk, performed similarly, and by a similar articulation, much less visible, however, than the others. These motions are wholly independent, as is proved by experiment. If the partial footstalks are moved, and collapse toward the petioli, or these toward the trunk, the little leaves, whose motion is usually primary to these, should be affected also; yet it is possible to touch the footstalks so as to aff ct them only, and make them apply to the trunk, while the leaves do not feel the touch: but this only when the footstalks can fall to the trunk, without their leaves touching any part of the plant in their passage; else they are immediately affected.

Winds and heavy rains make the leaves contract and close; but not slight showers. At night, or when exposed to much cold in the day, the leaves meet and close same as when touched, folding their upper surfaces together, and in part over each other, like scales or tiles, so as to expose as little as possible of the upper surface to the air. The opposite side of the leaves (foliola) do not come close together in the night, for when touched they apply closer together. Dr. Darwin kept a sensitive plant in a dark place for some hours after day-break; the leaves and footstalks were collapsed, as in its most profound sleep; and, on exposing it to the light, twenty minutes passed before it was expanded.

In August, a sensitive plant was carried into a dark cave, the motion in carrying shut up its leaves, which did not open till twenty-four hours afterwards; when they became moderately open, but remained afterwards subject to no changes at night or morning for three days and nights, their leaves in the same moderately open state. At the end of this time being brought again into the air, they recovered their natural periodical motions, shutting every night, and opening every morning, as naturally and strongly, as if the plant had not been in this forced state.—While in the cave, it was very little less affected with the touch than when abroad in the open air.

The great heats of summer, in open sunshine at noon, affect the plant like cold, causing it to shut up its leaves a little, but never very closely. The plant, however, being less affected, about nine o'clock in the morning, that is the proper time to make experiments. A branch of the sensitive plant cut off, and laid by retains for some days its property of shutting up and opening in the morning, and much longer if kept with one end in water.

The leaves only, not the branches, shut up in the night, and if touched at this time, the branches are affected same as in the day, shutting up, or approaching the stalk or trunk, often with more force. The substance which touches the plant is immaterial, it answers alike to all; but a little spot may be observed distinguishable by its paler colour in the articulation of its leaves, where the greatest and nicest sensibility is evidently placed.

The parts which have collapsed, afterwards unfold, and return to their former expanded state. The time varies, according to the season, the hour, the vigour of the plant, and the state of the atmosphere. Sometimes half an hour is requisite, sometimes only ten minutes. The order in which the parts recover themselves likewise varies; sometimes the common footstalk; or the rib to which the leaves are attached; or the leaves themselves, are expanded, before the other parts attempt to be reinstated in their former position.

If the end of one of the leaves be burned by a candle, or a burning glass, or hot iron, it closes in a moment, and also the opposite leaf, and then the whole series on each side of the little footstalk; then that, then the branch or common footstalk, all do so, if the burning has been violent. This proves the very nice communication between all the parts, by which the burning, only applied to the extremity of one leaf, diffuses its influence through every part. If a drop of aquafortis be carefully laid upon, so as not to shake the leaf, it does not move till the acrid liquor corrodes its substance; but then not only that particular leaf, but all the leaves on the same footstalk close up. The vapour of burning sulphur has a similar effect on many leaves at once, as they are more or less exposed to it; but a bottle of sulphuric acid unstopped, under the branches, produces no such effect. Wetting the leaves with spirit of wine, or oil of almonds, has no effect; though this last application destroys many plants.

From these experiments the following conclusions may be fairly drawn: The contraction of the parts of the sensitive plant, is occasioned by an external force, and is in proportion to that force. All bodies which can exert any force, affect the sensitive plant; some by the touch or by agitation, as the wind, rain, &c.; some by chemical influence, as heat and cold. Touching or agitating the plant, produces a greater effect than an incision, or cutting off a part, or by applying heat or cold.

The *Dionea Muscipula* resembles the *drosera rotundifolia*, or round-leaved sun-dew of our native bogs; the leaves of which are fringed with hairs, supporting small drops or globules, of a pellucid liquor resembling dew, which continue during the hottest part of the day, and in situations exposed to the fullest action of the sun-beams.

Perhaps the acrimony of the plant is contained in this secreted liquor, which is sufficiently caustic to corrode the skin. Few persons have observed the drosera in its native bogs without remarking that some of the leaves are doubled up; the cause of which has been lately ascertained by the researches of Mr. Whately. On inspecting some of the contracted leaves, he was surprised to observe a small fly or insect closely imprisoned in each, and was accordingly induced to press the others concentrically with a pin. A sudden and elastic spring of the leaves was immediately discoverable; they became inverted upwards, and encircled the pin, evidently showing the extraordinary means by which the flies came into their embarrassing situation. A German naturalist has also given the following interesting account of the result of a series of experiments on the drosera rotundifolia.

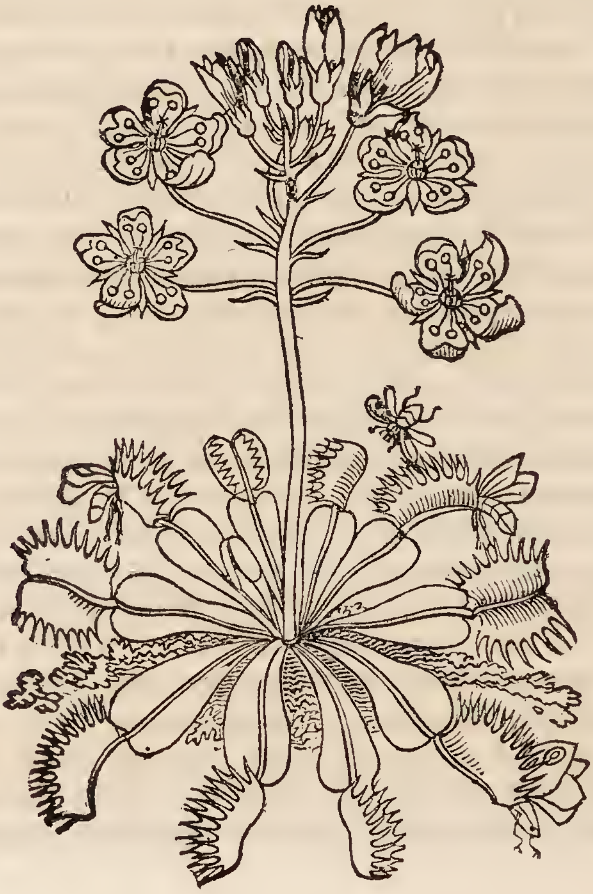
An ant was placed on the middle of a leaf of the rotundifolia, in such a manner as not to disturb the plant. The ant endeavoured to escape, but was held fast by the clammy juice at the points of the hairs. In a few minutes the long and short hairs on the disk of the leaf began to bend, and laid themselves upon the insect. After a while the leaf also began to move, and in some hours the edges were so completely bent inwards as to touch the base. The ant died in fifteen minutes. On repeating this experiment, the same effect followed sooner or later, according to the state of the weather. At eleven in the morning he placed a small fly in the centre of a leaf; this insect died sooner than the ant, and at five in the evening the leaf was closely compressed. The same experiment was also made on the drosera longifolia, with a similar result, only the irritability of the plant appeared greater. In sultry weather, when the sun is at its height, the drops of juice are most considerable on the extremities of the leaf, and the experiment succeeds best. If the insect is very small, sometimes only one edge of the leaf is folded up: this, however, answers the purpose, and crushes the little prisoner to death.

Dr. Darwin, in his botanical garden, gives the following beautiful illustration of the peculiar properties of these plants.

> The fell Silene, and her sisters fair,
> Skill'd in destruction spread the viscous snare,
> The harlot band *ten* lofty bravoes screen,
> And frowning guard the magic nets unseen.
> Haste glittering nations, tenants of the air,
> Oh steer from hence your viewless course afar!
> If with soft words, sweet blushes, nods, and smiles,
> The *three*-dread Syrens lure you to their toils,
> Limed by their art, in vain you point your stings,
> In vain the efforts of your whirring wings!
> Go seek your gilded mates and infant hives,
> Nor taste the honey purchased with your lives.

VENUS'S FLY-TRAP. *(Dionea Muscipula.)*

Is a curious instance of extreme irritability, resulting from extraneous substances. It is a native of the bogs of Carolina, and flowers in June and August.



The flowers are milk-white; the leaves are nearly three inches long, and an inch and a half wide; the glands of those which are exposed to the sun are of a beautiful red colour, whilst those in the shade are pale, or rather green. Their formation is extremely curious; they are very numerous, inclining or bent downwards; placed in a circular form, jointed and succulent; the lower joint is a kind of stalk, flat, longish, two-edged, and inclining to heart-shaped. The upper joint consists of two lobes, each of a semi-oval form, with their margins furnished with stiff hairs, like eye-brows, which embrace or lock in each other when they close, which universally occurs on the slightest irritation. The upper surface of the lobes is covered with minute glands, each, when highly magnified, appearing like a compressed arbutus berry.

It is conjectured that the liquor which they contain is peculiarly attractive to the insect tribe, as they frequently resort to them. No sooner, however, does the poor insect attempt to rest on the little sparkling globes, than the tender parts, irritated by the feet, lock the two rows of spines together, and squeeze it to death. And further, to prevent the possibility of escape, lest the strong efforts of the imprisoned insect should disengage it, three small erect spines are fixed near the middle of each lobe, among the glands, that effectually put an end to all its struggles. Nor do the lobes ever open again, while the dead animal continues there; for so strong has nature formed the spring of their fibres, that they more readily break than yield to the pressure of the hand.

It is however certain that the plant has no perceptive powers, by means of which it can dintinguish an insect from any other substance; for if a straw or pin be introduced between the lobes, the same motions are excited. Dr. Darwin says, that the sweet viscous liquor just mentioned, is a curious contrivance of Nature, to prevent various insects from plundering the honey, or devouring the seed.

The Wonderful Plant of SOMBRERO, is a kind of sensitive plant growing in the East-Indies, in sandy bays and in shallow water. It appears like a slender straight stick, but when attempted to be touched it immediately withdraws itself into the sand. Mr. Miller says, the

Malays call it *lalan lout*, that is, sea-grass. He never could observe any tentacula; but, after many unsuccessful attempts, drew out a broken piece about a foot long. It was perfectly straight and uniform, and resembled a worm drawn over a knitting-needle. When dry it appears like a coral.

The *Averrhoa Carambola*, called in Bengal the *camrue*, or *camrimga*, grows to the height of fourteen feet; and is remarkable for possessing powers in a great degree analogous to those species of *mimosa* which are termed sensitive. The leaves are alternately pinnated with an odd one; and their common position in the day is horizontal. On being touched they move themselves downwards, frequently in so great a degree, that the two opposite touch one another by their opposite sides; and those of a latter production either come into contact, or pass one another. All the leaves of one pinna move when the branch is touched with the finger, nail, or any hard substance; or each leaf can be moved singly by making an impression solely on the leaf.

Notwithstanding this apparent sensibility, large incisions may be made in the leaf itself, with a pair of sharp scissars, without occasioning the smallest motion; nay, it may even be cut almost off, and the remaining part will still continue unmoved; but as soon as the *petiolus* is touched with a finger, or scissars, an evident sensibility is immediately produced. After sun-set the leaves move down so as to touch one another by their under sides, apparently as much affected by the action of the damp night-air, as by any extraneous body. By means of a convex lens the rays of the sun may be collected on a leaf of the *camrimga*, so as to burn a hole in it, without occasioning any motion; but, upon trying the experiment on the petilous, a rapid and instantaneous motion is immediately produced; although the rays should not be so much concentrated as to occasion any pain on the hand of the operator. The leaves are capable of being very powerfully excited by a slight electric shock.

THE ANIMATED HEDYSARUM, OR MOVING PLANT,

GENERALLY rises to the height of two or three feet: the leaves are of a bright green, with the middle part of a more glaucous appearance than the rest: the flowers are of a pale red, slightly tinged with blue, and sometimes yellow. It grows in the interior of Bengal. The motion of the plant consists in the alternate meeting and receding of two small appendages or leaflets on each side of the footstalks, and which are engaged in this gentle exercise during the greatest part of the day.

Dr. Darwin thus describes the Hedysarum:—

Fair Chunda smiles amid the burning waste,
Her brow unturbaned and her zone unbraced;
Ten brother-youths with slight umbrellas shade,
Or fan with busy hands the panting maid;
Loose wave her locks, disclosing as they break,
The rising bosom and averted cheek;
Clasped round her ivory neck with studs of gold
Flows her thin vest in many a gauzy fold;
O'er her light limbs the dim transparence plays,
And the fair form, it seems to hide, displays.

The causes inducing the contractions of different plants, and of the same plant, are very numerous. A touch of the hand, a scratch, heat, cold, strong smells, and many other stimuli produce this effect. By these means many experiments have been made on plants possessing irritability in perfection, and for that purpose the *Mimosa sensitiva* has been generally selected. Some stimuli seem, as we have hinted before, destined to produce certain determinate effects in certain plants, and are therefore applied by natural means; others again appear to have merely an accidental influence. Thus, the *Porliera hygrometrica*, a South American shrub, contracts its feathery leaves on the approach of wet weather, which it indicates with unerring certainty. The leaves of the *Oneclea sensibilis*, a species of North American *Filix*, when unfolding themselves, shrink on the least touch. The *Mimosa sensitiva*, so frequently mentioned, is affected by almost every means that can be applied. On the other hand, the *Dionæa muscipula* does not close its singularly-constructed leaves until some animal has entered into its bosom, nor does it open until all motion on the part of the confined insect has ceased. Analogous facts have been observed connected with the genus *Drosera*.

Light has a very powerful influence on vegetation, and it also produces a very striking effect on the irritability of leaves; plants being uniformly observed to present their leaves to the side on which the largest quantity of light is to be found. This fact is daily exemplified in hot houses and on walls. The experiment can be easily made with a common geranium, or any of those plants that are usually placed in windows; by reversing their usual position, in a short time the leaves will be found to have turned completely round to the window.

Some ingenious philosophers attempt to explain the cause of this turning round of the leaves of plants when placed in unnatural situations; and, in addition to the influence of light, the agency of heat and moisture have been called in, and very probably, in some cases, they may act conjointly, though it is highly improbable that this happens in every instance. Bonnet supposed that the two last-mentioned causes were the sole agents, and attempted to produce their effects by artificial means; and he succeeded in exciting motion in leaves by alternately presenting a bar of red-hot iron to the superior surface, and a moistened sponge to the under side.

Many plants close their leaves at a certain period of the day, and open them at another regular period: this may be seen in any garden at night; but it is particularly remarkable in the *Mimosa sensitiva*, the tamarind-tree, and many others, but more especially those of pinnated leguminous plants. This periodical folding of the leaves has been called by Linnæus the sleep of plants, and the term is now generally used, in spite of the objections that may be urged against it. If we examine it accurately, there will be found little or no reason for rejecting it on account of the implied analogy; for it is not at all improbable that this folding of the leaves may, as Dr. Smith expresses it, “be useful to the vegetable constitution, as real sleep is to the animal.” This particular state of the leaves also protects the flowers from the dew. The phenomena of sleep were first noticed by Garcias, in the tamarind-tree, in his voyage to the Indies; but the determination of the general fact was reserved for the illustrious father of scientific botany. The discovery was accidental, though a less curious mind than that of Linnæus would have overlooked the circumstance which led to it. Having reared a few plants of the Lotus, the seeds of which he had received from Sauvages, he remarked in the morning a pair of very thriving flowers, which disappeared at night. They, however, re-appeared the following day, which excited Linnæus’ attention, and he commenced his nightly examinations, by which he ascertained many of the most valuable facts that we now possess.

Bonnet's hypothesis has been extended to explain it; and many other suppositions, equally unsatisfactory, have been advanced. Linnæus thought that it was induced by the absence of light. Hill pushed this opinion still further, and endeavoured to establish it by some plausible experiments. Decandolle lighted up a dark cave with lamps, in which he had placed the plant at midnight; the leaves expanded, and in the following day they closed, on extinguishing the light; but he did not succeed in his attempts to induce the same results in other plants of an equally irritable habit. This folding up of the leaves, or sleep, appears to be the result of certain actions of other causes on the irritability of the plant, and among these causes light appears to maintain a very high rank. The various living phenomena of every vegetable give force to these suppositions; but the mode of action is beyond our reach: we must be satisfied with learning the general laws by which nature conducts her operations.

There is another class of operations performed by the leaf, which merits and has obtained much careful examination. Those chemical effects which are induced by leaves on the surrounding atmosphere; and the influence of light and heat in promoting those effects, as well as some others. Whatever difference of opinion exists with regard to the influence of light and heat on the leaf, there can be no doubt that air is indispensably necessary for its existence. This fact, as well as the relative influence of the leaf on the air, has been demonstrated by Hales, Duhamel, Knight, and others, in the most ample and satisfactory manner. It having been once determined that air is required for vegetation, the next objects of inquiry are, what portion of the atmospherical air is employed; whether a part or the whole of it is consumed; and what are the agents engaged in conducting the process.

After a most laborious and careful set of experiments on myrtles, beans, willows, and other plants, Mr. Ellis arrived at the general conclusion, "that the oxygen gas of the atmosphere is converted into carbonatic acid gas by the process of vegetation; and that the bulk of the latter gas nearly or exactly corresponds with that of the former; and consequently the experiments demonstrate that the air is deteriorated by the growth of plants, in the same manner as by the germination of seeds, and that no part of the oxygenous portion of the atmosphere combines with the substance. Plants which vegetate in sunshine require always the presence of oxygen gas; and that, by the act of vegetation, they constantly change this oxygen into carbonic acid. We farther learn, that carbonic acid enters plants, both with the fluids which they absorb, and also, under certain circumstances, in an elastic form; that this acid gas is conveyed to the leaves, and is there decomposed by the joint operation of the plant and of solar light; and that it is from this source alone, that the oxygen gas afforded by plants is derived. It likewise appears, that this operation of affording oxygen is not properly a vegetative function, but only a subordinate office, accomplished by the direct agency of the sun; that it is carried on in the cellular or parenchymatous structure, and not in the vascular system of the leaf; and that it may, and does exist with that function by which oxygen is consumed, and which is essential to the vegetation of the plant. Hence it is, that, when plants are made to grow in closed vessels exposed to the sun, the oxygen gas which is consumed by the function of vegetation, is again restored by the decomposition of the acid that is formed, and no change, therefore, appears to be effected in the composition of the air. But in situations, where the direct agency of light is excluded, no decomposition of carbonic acid is perceptible, and the air, therefore, soon becomes unfit to sustain vegetation. In its general nature and effects, therefore, the function of vegetation is precisely the same in sunshine and in the shade, for oxygen gas is alike necessary in both situations, and is in a similar manner converted into carbonic acid. Under direct exposure to the solar rays, however, this acid gas is again decomposed, and its oxygen is restored to the asmosphere; while, in the shade, no such operation takes place, and the air, therefore, remains permanently depraved. But farther, it also appears, that the production of oxygen is entirely confined to the leaves and other green parts of plants; and that the flowers, the fruits, the stems and roots of vegetables, both in sunshine and in the shade, convert always the oxygen gas of the air into carbonic acid."

We have in a former part hinted at the supposed purification of the atmosphere by means of plants. The beauty of the idea has led many to adopt it, without investigating its truth; and Mr. Ellis has here, too, thrown down the gauntlet;—he asserts, that the means supposed to effect such great ends are wholly inadequate, and that although there are certainly some means by which the air is freed of the noxious ingredients derived from vegetation, germination, and respiration, yet the present state of chemical science does not permit us to say what they are. Mr. Ellis meets, with energy, the cavils of those who may urge the doctrine of this purifying process as necessary in the economy of nature, and as illustrative of the wisdom of Providence. "It behoves us," says he, "to employ no ordinary portion of delicacy and caution in pronouncing on the general plans and purposes of Providence, from the little and partial views of nature, which at present we are permitted to take, lest, in the effervescence of our zeal, we degrade the wisdom we pretend to exalt, and pervert the designs of the goodness we profess to revere."

The colouration of plants presents one of the most interesting, and, at the same time, obscure branches of physiological research. Humboldt attributes the green colours of leaves to the agency of hydrogen, because he had observed some plants retain their green colour in mines. Saussure, however, could not increase the green of plants by means of hydrogen. Humboldt also ascribed the white colour to oxygen, which seems to be erroneous, as this oxygen existed in a state of combination previous to its being made apparent, and cannot therefore be proved to produce this white colour. Senebier's phlogistic hypothesis is unworthy of detailed notice. His subsequent opinions respecting the operation of carbon, do not seem to be better founded. This philosopher, as well as Berthollet, determined many important facts. There is a very evident connexion between the decomposition of carbonic acid gas and the green colour of leaves, as is shewn by the following results. Green leaves only yield oxygen gas; the parenchymatous substance of the leaf is the seat of decomposition of the gas, and of the green colour; the colouration will take place in leaves separated from the stem, so that there can be no living action in them; consequently, the colouration is independent of the life of the plant.

It appears, from the various experiments of Berthollet, Senebier, and others, that solutions of the colourable parts of leaves are rendered red or green according to the predominance of acid or alkaline matter; but similar effects will be also induced on entire leaves. Etiolated leaves, and those reddened by age, pass into green in alkaline fluids; those that are yellow from decomposition become brown in the same circumstances. Ellis observed, that if the green colour had been previously affected by the action of water, that alkalies did not restore it. On these facts this physiologist ventures to presume, "that these same agents (acids and alkalies) if present, will exert a similar action on leaves during their growth."

He first establishes the existence of a large quantity of alkaline matter in the leaves, and then shews that the separation of the carbonic acid, and its subsequent decomposition, render the alkali predominant, and consequently better fitted to exert its specific influence "on the colourable juices of the plant," which produces the green colour of the leaf. So that, according to Mr. Ellis's views, the decomposition of the carbonic acid answers two purposes, the production of oxygen gas and the formation of the green colour. After a full examination of the facts and opinions that are maintained on the subject of colouration, the following are his genera conclusions. "We may observe, in the first place, that by the chemical agency of this subtile matter, the salin compounds of plants are decomposed, and the acid an alkaline matter, thus developed, combine with th colourable juices of the vegetable. In consequence o this combination, these juices are enabled to act variously on the luminous rays. When the alkali predominates, the more refrangible rays, as the violet, blu and green, are reflected, and the other rays are extinguished; when the acid prevails, the least refrangibl or red rays, are reflected, and the others disappear; an from intermediate admixtures of these ingredient intermediate colours, both simple and compounde will arise. The colours, however, which these juic present to our sight, are not reflected by the coloured particles, but by the opaque matter on which they are imposed, so that the coloured matter transmits, but does not reflect, light; and this light arriving at the eye, produces an impression, which conveys the sensation of the individual colour.

Hence, too, it follows, says Mr. Ellis, that, when light is wholly excluded, the chemical changes in the vegetable juices, which enable them to exert these actions on the colorific rays, do not take place, and consequently the green colour of the leaves, which depends on the predominance of alkaline matter, and the red colours of leaves and of flowers, which arise from an excess of acid, are equally prevented from appearing; for the juices being unable, in this state, to decompose the solar beam, return it almost or entirely unchanged to the eye, whence the objects are destitute of colour, or have the appearance of whiteness. The colours of plants, therefore, depend primarily on the chemical action of light, in changing the constitution of their juices; and these juices, by their physical operation on the colorific rays, are then enabled to exhibit all their infinite variety of hues."

The most remarkable example of the heat in vegetables is given by M. Hubert. He relates, that the spadices of the *arum cordifolium*, which grows in Madagascar and the Isle of France, indicated a most remarkable degree of temperature, in the course of some observations that he made upon them. On applying a thermometer to five spadices which had unfolded in the preceding night, a rise of 25° from the temperature of the atmosphere took place; the following morning, the difference between the temperature of the spadices and of the surrounding atmosphere was reduced to 21°, and in the evening of the same day to 7°.

From these, and other facts, Mr. Ellis deduces the following conclusions: "That the oxygen gas of the air is converted into carbonic acid, by carbon exhaled by the living plant, whereby the greater part of the specific caloric of that gas is disengaged. It is to this change of composition in the air, and consequent extrication of its heat, that the increased temperature observed in plants, during their vegetation, is to be ascribed." But it is evident, that, in the proportion in which vegetables fix gas, they must exhibit heat by the gas parting with its motion to the parts, as in the case of animal heat.

Thus we find, that the perfect plant is not only composed of solid parts, containing vessels which convey certain fluids, but that each of these parts perform determinate functions, which contribute to the well-being of the whole. We have seen, that the root absorbs nourishment; that the leaves, under certain circumstances, absorb moisture; that the fluid nourishment, taken in by the roots, circulates through the stem, the leaves, and the bark; that the plant perspires an aqueous fluid; that it forms peculiar depositions; that carbonic acid is formed by the union of carbon evolved in a fluid with the oxygen of the atmosphere; that carbonic acid, taken into the system with the food, and by other means, is decomposed in the leaf; that heat is disengaged by the formation; that the colouration is effected by the decomposition of the carbonic acid; and that the processes of assimilation are going on, as is evident to our senses, by the effects.

What pomp, what vast variety of hues
The woodland scenes adorn. The purple deep,
Orange, and opal, and carnation bright,
To the rapt eye their rich profusion spread.
Alas! this splendour all bespeaks decay.
Such is the common lot. The north winds soon
Their sylvan spoils will strow along the vales.
The leaf incessant flutters to the ground,
And, flutt'ring, startles such, who musing stray,
Lonely and devious through the solemn shades.
Yet have these leafy ruins charms for me.
There, should my heart some poignant woe conceal,
And sad Remembrance ope the bleeding wound,
How sweet to mingle then my sorrowing gloom,
With the deep gloom that saddens all the scene!
Wand'ring, recluse, how sweet to tread the spoils
Of the stripped woods and withered branches round!
The giddy days of gay aspiring Hope,
And all my youthful follies, now are fled.
Come then, O soothing Melancholy! come:
To thee each moment I devote: But come,
Not o'er thy visage hov'ring frightful clouds,
Involved in which depressing Sorrow walks,
But with eye half-veiled, as in Autumn when,
Through congregated fogs, a brighter sun
With sudden radiation cheers the day:
O Come, with pensive look, and front serene,
While the big drops sit trembling in thine eye,
Or steal adown thy cheek delicious tears. De Lille.

LECTURE LXXXII.

BRITISH VEGETATION.

Though the climate of Britain is unfavourable to the growth of the immense Trees and Plants which flourish within the Tropics, yet it yields every thing necessary and substantial for the food of its dense and increasing population. The British islands are remarkable for their perpetual verdure, which is not burnt up by the sun as in more southern climates, nor stunted into moss and lichen as in more northern regions. In a former lecture the principal Trees of Britain have been fully described.

No branch of vegetation is so well calculated to exhibit the beauty of nature, as the several varieties of **Grasses**, many of which present the most elegant forms.

The Grasses, so extensively useful in rural economy, are chiefly to be found in the second order of the third class, *triandria digynia*, in the Linnæan system. However numerous they may be, and distinct from each other, they generally agree in the following circumstances; which, taken together, form the natural character of this tribe or family. The *calyx* is a glume or chaff, in most species composed of two valves, one larger and gibbous, the other smaller and flat. The *corolla* also is a bivalve glume, and is accompanied by a very small, superior, two-leaved nectarium, of an oblong form. The *stamens* are three in number; the filaments capillary; the antheræ oblong and bicapsular. There are two *pistilla*, which are pubescent, reflex, or bent back from each other, and terminated by pubescent stigmas. One *seed* only, or grain, succeeds to each flower; it has no pericarp, but is covered by the calyx, corolla, or both; it is of an oblong form, drawn to a point at both ends, and composed of one lobe only.

Artificial grasses, viz. clover, lucern, saintfoin, trefoil, &c. are mostly leguminous plants, totally different in every respect from grasses, except in being used as food for cattle.

The accompanying engravings exhibit sixteen beautiful varieties of British grasses.

1. *Silver Hair Grass*, found on the best pastures.

2. *Fine Bent Grass*, found in great abundance in similar situations.

3. *Sheep's Fescue Grass*, so much esteemed as the sweetest feed for sheep, and common on sheep-downs.

4. *Purple Fescue Grass*, found on sheep-downs, with fine bent and silver hair-grass.

5. *Ray, or Rye Grass*, is in constant cultivation, though it is deficient in some of the properties requisite for meadow or pasture lands. Its foliage is of a rapid growth, the flowering stems continually shooting forth.

6. *Mountain Hair Grass*, is abundant in the best sheep pastures.

7. *Annual Meadow Grass*, which makes the finest turf, grows every where by way-sides, and on rich sound commons. In some parts it is called *Suffolk Grass*.

8. *Flote Fescue Grass*, is a very fattening grass when growing in water.

9. *Crested Dog's-tail Grass*, is proper for deer in parks, and for sheep; and making a fine turf upon dry sandy or chalky soils. This species is much recommended as a favourite and wholesome food for sheep. It is found in the soundest, richest pastures, but grows best in dry situations, and will not thrive in meadows that are very moist.

10. *Sweet-scented Vernal Grass* comes early into blossom, and is valuable as spring grass, and also for its ready growth, in most kinds of soil and situation, being found in bogs, in woods of low growth, or which hav had the underwood removed, in water meadows, and in dry pastures; but in point of crop it is not so produc tive as some, yet more so than others. It is the onl grass of this climate which is strongly odoriferous; th agreeable scent of new-made hay being produced almos entirely by it; and the green leaves, when bruised, rea dily impart this odour to the fingers, by which mean the foliage may constantly be known; and it may b readily distinguished when in blossom, by its havin only two threads or stamina to each flower.

11. *Creeping Meadow Grass.*

12. *Great Meadow Grass*, which, together with th narrow-leaved sort, is common in the best meadow and makes both good pasture and hay.

13. *Meadow Fox-tail Grass*, sends forth its spike almost as soon, and in some situations full as early, as the sweet-scented vernal; consequently, it is equally valuable as an early spring grass; and as it is larger and quicker in its growth, it is of course much more productive: it shoots rapidly after mowing, producing a very plentiful after-math: and where the land is rich, and two crops are not thought too much for it to bear; of all the grasses of this climate it appears to be the most favourable for such a purpose, and ought to form a principal part of the crop in such cases.

14. *Bulbous Fox-tail Grass*, is of the same class as the foregoing.

15. *Creeping Soft Grass*, is common in meadows and pastures, and is both hardy and productive of foliage, but flowers much later than the first of the above grasses: its foliage is soft and woolly; whence its characteristic name.

16. *Small Grass-leaved Plantain.*

Smooth-stalked Meadow Grass begins to shoot and to assume a beautiful verdure at an early period of the spring; but the flowering-stems are not produced so soon, by a week at least, as those of the last: this slight difference, in point of earliness of flowering, does not, however, prevent it from being properly ranked with the two preceding grasses.

Rough-stalked Meadow Grass has much similarity to the preceding in its appearance, especially in the mode of flowering; it differs essentially in its qualities; as the former is chiefly found in dry pastures, while the latter principally occurs in water-meadows.

Meadow Fescue Grass approaches in its appearance to ray grass, but to which it seems greatly superior, at least for the purpose of improving meadows; as being larger, and more productive of foliage.

Tall Oat Grass is almost every where found abundantly in meadows, and is cultivated on the continent with advantage.

Meadow Cat's-tail, or Timothy Grass, succeeds best in all moist soils and situations, is very productive, but coarse. In America, it constitutes the principal support of cattle and other animals, in their deep savannahs and lands of the natural meadow kind.

Of the various grasses and other plants, on which domesticated animals subsist, the cow consumes two hundred and eighty-six, in her usual pasturage; and rejects one hundred and eighty-four.

The Goat consumes four hundred and eighty-eight; rejecting ninety-two.

The Sheep consumes four hundred and seventeen; rejecting one hundred and twelve.

The Horse consumes two hundred and seventy-eight; rejecting two hundred and seven.

The Hog consumes one hundred and seven; rejecting one hundred and ninety.

The following are esteemed the most useful and beneficial to the generality of farmers and graziers, viz. the sweet-scented vernal grass; meadow fox-tail grass; smooth-stalked meadow grass; rough-stalked meadow grass; meadow fescue grass; sheep's fescue grass; hard fescue grass; crested dog's-tail grass; ray or rye grass; meadow soft grass, or Yorkshire white; rough cock's-foot grass; tall oat grass; meadow cat's-tail, or Timothy grass; and the valuable artificial grasses.

The calyx of Wheat, (*Triticum*,) is bivalve, solitary, and generally containing three florets; the corolla bivalve, one bluntish, the other acute. Linnæus comprehends six different kinds of wheat, but cultivation has produced many varieties.

Spring-Wheat, (*æstivum*,) has four flowers in a calyx, three of which mostly bear grain. The calyces stand distant, on both sides a flat smooth receptacle. The leaves of the calyx are keel-shaped, smooth, and terminate with a short arista. The glumes of the flowers are smooth and bellying, the outer leaf of three in every calyx terminated by a long arista, the three inner ones beardless. The grain is rather longer and thinner than common wheat.

The farmers call it Spring Wheat, because it will come to the sickle with the common wheat, though sown in February or March.

Winter, or Common Wheat, (*hybernum*,) has four flowers in a calyx, three mostly productive. The calyces stand close on each side a smooth flat receptacle; the leaves bellying, and smooth, as if polished, but without arista; the glumes are smooth, and the outer ones near the top of the spike often tipped with short aristæ. The grain is plump, and is generally sown in England; whence the name of common wheat.

THICK SPIKED, or CONE-WHEAT, (*turgidum*,) is easily distinguished from either of the former; for though it has four flowers in a calyx, yet the whole calyx and the edges of the glumes are covered with soft hairs. The calyces standing thicker on the receptacle, the spike appears more turgid. Some of the outer glumes near the top of the spike are terminated by short aristæ. The grain is shorter, plumper, and more convex on the back than either of the former species. This sort is very productive, but yields an inferior flour to the former.

POLISH WHEAT, (*Polonicum*,) has some resemblance to the turgidum, but both grain and spike are longer. The calyx contains two flowers, the glumes furnished with long aristæ; the teeth of the midrib bearded. This sort is seldom sown in England.

SPELT, or GERMAN WHEAT, (*Spelta*.) At first view has a great resemblance to barley, but has no involucrum. The calyx truncated, it appears as if the ends were snipped, and contains four flowers, two hermaphrodite and the glumes bearded, the intermediate ones neuter. There are two rows of grain as in barley, but they are shaped like wheat. It is much cultivated in France, Germany, and Italy.

ST. PETER'S CORN, or ONE-GRAINED WHEAT, (*monococcum*,) has three flowers in each calyx alternately bearded, and the middle one neuter. The spike is shining, and has two rows of grain like barley. It is cultivated in Germany, and in conjunction with spelt wheat is made into bread, coarse, and less nourishing than common wheat.

The OAT, one of the numerous families of grasses, have all three males, and two females, except Anthoxanthum, which gives the grateful smell to hay, and has but two males. The herbs of this order of vegetables support the countless tribes of graminivorous animals. The seeds of the smaller kind of grasses, as of *aira*, *poa*, *briza*, *stipa*, &c. are the sustenance of many sorts of birds. The seeds of the large grasses, as of wheat, barley, rye, oats, supply food to the human species.

Of our garden and field vegetables the most useful and productive is the Potatoe, whose name in botany is Solanum, of the class *pentandria*, and order *monogynia*, which includes the various kinds of night-shade, among which the tuberous rooted night-shade is the common potatoe; it is believed that this useful, prolific, and wholesome root, was a native of Peru or Paraguay, from which continent it was brought by Sir Walter Raleigh, and first planted on an estate of his near Cork. It quickly spread through Ireland, and within a century into Lancashire, in another half century through Great Britain, and is now generally cultivated in all parts of Europe; the principal varieties are the red rooted and the white rooted, of which there are numerous sub-varieties, and as a staple article of food, and for purposes of various manufacture, its introduction is one of the greatest blessings ever conferred on the world.

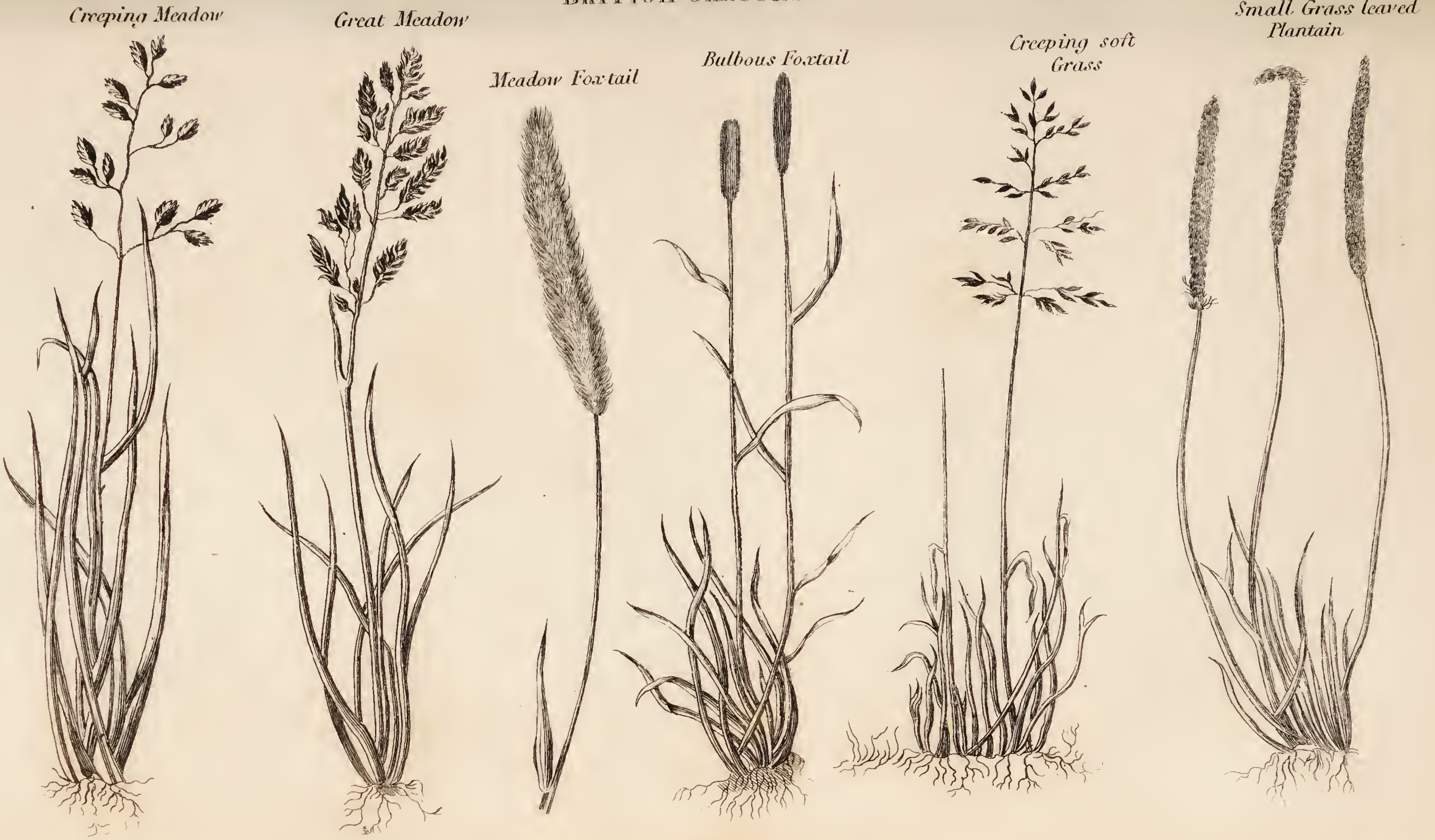
The next esculent root in importance is the genus Brassica, cultivated in our fields and gardens under the name of various cabbages, Brocoli, Turnips, and Cauliflowers; they are a genus of the order *siliquosa*, and of the class *tetradynamia*, and there are twelve species, most of which have been brought to the highest perfection in Britain, for the food of men and cattle.

Among our garden luxuries we may name Asparagus, a genus of the *monogynia* order and *hexandria* class; it was first cultivated in England at Battersea, where it still occupies great breadths of ground; but is now to be found in almost every private garden in England.

Beans, in botany *vicia*, belong to a genus of plants called *diadelphia*, and order *decandria;* there are twenty species, including the vetches or tares; and the third species is the common garden bean, a most nutritive and valuable seed for men and cattle.

Of equal importance in our domestic economy is the genus *pisum*, of the order *decandria*, and class *diadelphia* of which the first species is the *sativum*, or Garden Pea; and the second the *humile* or Dwarf Pea; and the third *umbilatum*, or Crown Pea; of which species a great number of varieties are cultivated in our gardens, and are too well known to be treated of as natural curiosities. The stamens are divided into two bodies,

BRITISH GRASSES.



Neele & Son 352 Stra

Silver Hair

Fine Bent

Sheeps Fescue

Purple Fescue

Rye Grass vulgo

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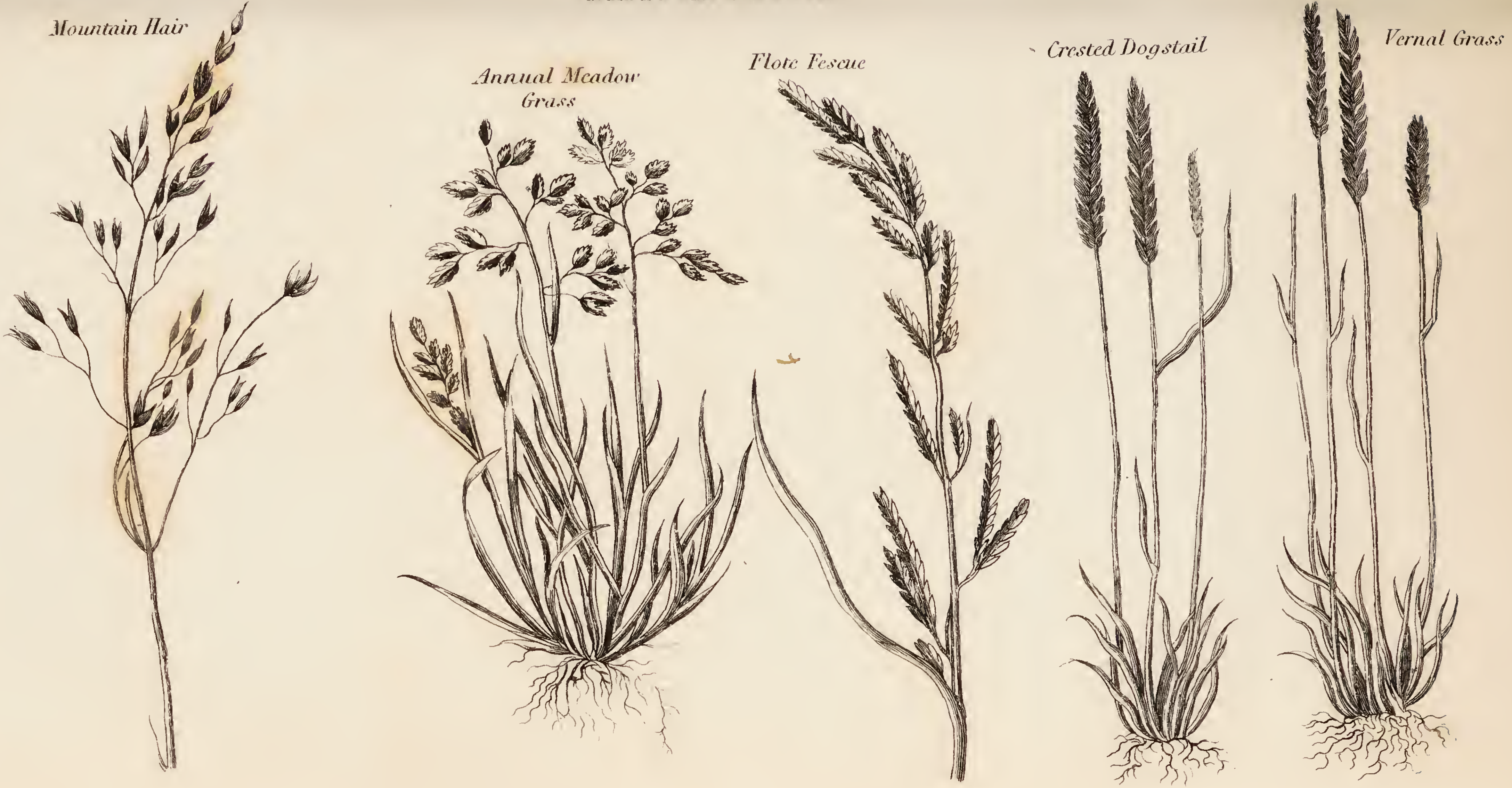
BRITISH GRASSES.



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the one containing nine, the other only one stamen; the seed-vessel is a legume, or pod. The plants of this natural order constitute a very numerous and useful tribe, most of them having fruit, esculent either to men, quadrupeds, or birds, as beans, peas, lucerne, clover, vetches, saintfoin, kidney-beans, &c.

The COMMON ANNUAL FLAX, (*usitatissimum,*) has a taper fibrous root; is upright, slender, and unbranched stalks, two feet and a half high; garnished with narrow, alternate, spear-shaped, grey-coloured leaves; and the stalks are divided into footstalks at top, terminated by small blue crenated flowers, in July; succeeded by round capsules of ten cells, containing each one seed.

The PERENNIAL SIBERIAN FLAX has a fibrous perennial root, sending up several upright, strong, annual stalks, branching four or five feet high; garnished with small, narrow, spear-shaped, alternate dark green leaves; and terminated by clusters of large blue flowers in June, which are succeeded by seeds.

The PURGING FLAX, with leaves opposite and lanceolate; is a very small plant, four or five inches high; and is found wild upon chalky hills, and in dry pleasure grounds. The second sort is raised from seed.

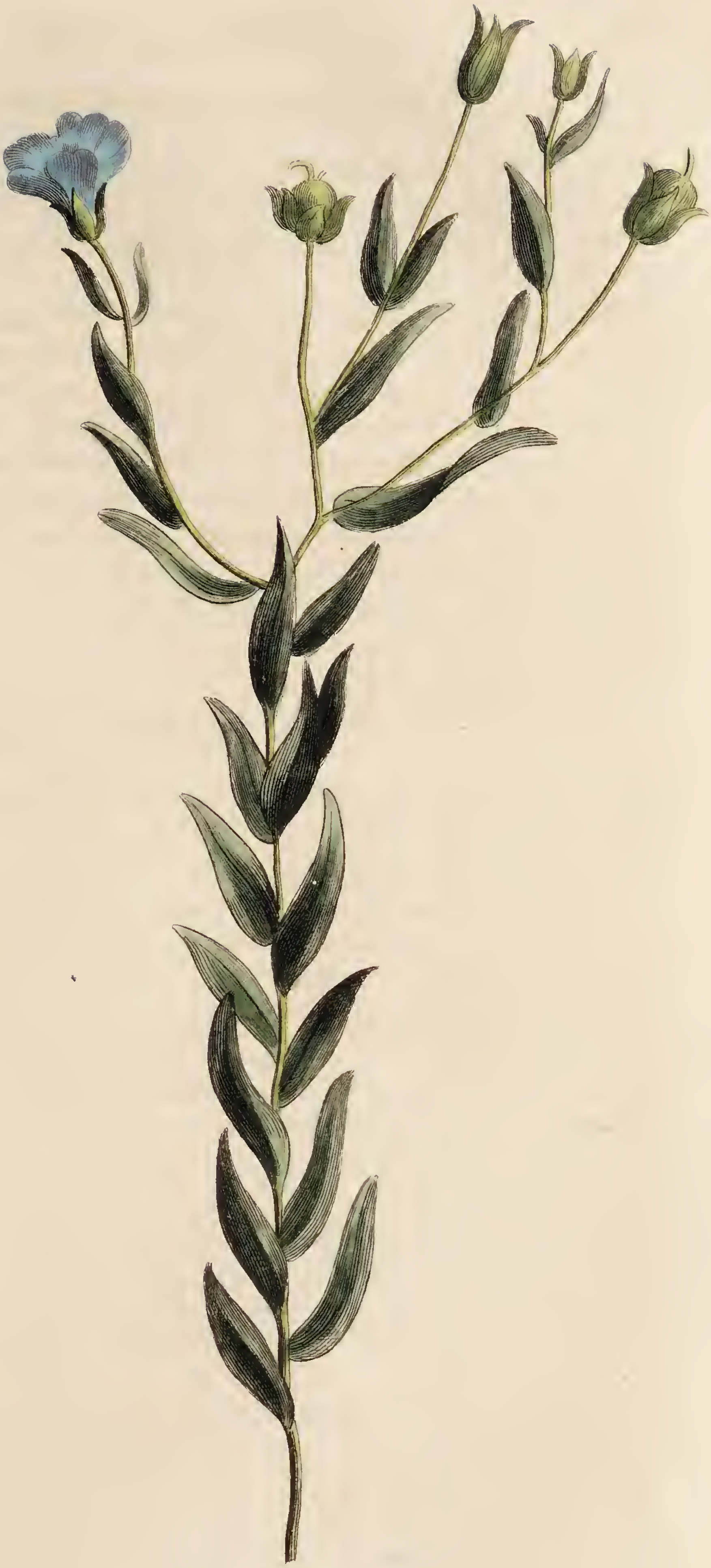
The first species may justly be considered as one of the most valuable of the whole vegetative kingdom; as from the bark of its stalks is manufactured the lint, or flax, for making all sorts of linen-cloth; from the rags of the linen is made paper; and from the seeds is expressed the linseed-oil so useful in painting and other trades.

The brightest and heaviest seed is the best; which, when bruised, appears of a yellowish green, fresh in the heart, oily and not dry, and smells and tastes sweet, not fusty. Dutch seed of the preceding year's growth, answers best; but seldom succeeds if kept another year. It ripens soonest. Philadelphia seed produces fine lint and few bolls, because sown thick, and answers best in wet cold soils. Riga seed produces coarser lint, and most seed. Scotch seed well-winned and kept, and with change of soils, sometimes answers; but should be sown thick. It springs well, and its flax is soon ripe; but its produce is inferior to that from foreign seed.

MUSTARD, of the class *tetradynamia*, and order *siliquosa*, has four long, two short stamens, and there are seventeen species of this genus, three of which are natives of Great Britain. *Sinapis alba*, or White Mustard, with white corollas, cultivated as a sallad herb for winter and spring use. *Sinapis nigra*, or Common Mustard, cultivated in fields for seed; and *sinapis arvensis*, the seed of which is sold under the title of Durham mustard. It grows naturally in many parts of Britain, among a corn generally known by the name of Charlock.

The KALI grows naturally in the salt marshes, in England; is an annual plant, which rises five or six inches high; many side-branches spread on every side, garnished with short awl-shaped fleshy leaves, which terminate in acute spines. The flowers are produced from the side of the branches, to which they sit close, and are encompassed by short prickly leaves; small, and of an herbaceous colour. The seeds are wrapped up in the empalement of the flower, and ripen in autumn, after which the plant soon decays.

The MADDER plant has four males and one female; is cultivated in very large quantities for dyeing red, if mixed with the food of young pigs it covers their bones red; if they are fed alternate fortnights with a mixture of madder, and their usual food, their bones will consist of concentric circles of red and white. Animals fed with the madder, for the purpose of these experiments, were found upon dissection to have thinner gall; this circumstance is worth farther attention. The colouring materials of vegetables, like those which serve the purpose of tanning, varnishing, and the various medical purposes, do not seem essential to the life of the plant; but seem given it as a defence against the depredations of insects, or other animals, to whom these materials are nauseous or deleterious. The colours of insects and many smaller animals contribute to conceal them from the larger ones, which prey upon them. Caterpillars which feed on leaves are generally green, and earthworms the colour of the earth which they inhabit; butterflies which frequent flowers are coloured like them; small birds which frequent hedges have greenish backs like the leaves, and light-coloured bellies like the fly, and are hence less visible to the hawk, who passes under them or over them. Those birds which are much amongst flowers, as the goldfinch, are furnished with vivid colours. The lark, partridge, and hare, are the colour of dry vegetables, or earth on which they



Linum Usitatissimum _ Common Flax.

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rest. And frogs which are generally suspended in water, and swallows which are generally suspended in air, have their backs the colour of the distant ground, and their bellies of the sky. In the colder climates many of these become white during the existence of the snows. Hence there is apparent design in the colours of animals, whilst those of vegetables seem consequent to the other properties of the materials which possess them.

The THISTLE, and many other plants of the same class, have seeds furnished with a plume, by which admirable mechanism they perform long ærial journies, crossing lakes and deserts, and has thus disseminated far from the original plant, and have much the appearance of a shuttlecock as they fly. The wings are of different construction, some being like a divergent tuft of hairs, others are branched like feathers, some are elevated from the crown of the seed by a slender footstalk, which gives them a very elegant appearance; others set immediately on the crown of the seed.

Nature has many other curious vegetable contrivances for the dispersion of seeds; but perhaps none of them has more the appearance of design than the admirable apparatus of the *tellandsia* for this purpose. This plant grows on the branches of trees like the mistletoe, and never on the ground; the seeds are furnished with many long threads on their crowns, which, as they are driven forwards by the winds, wrap round the arms of trees, and thus hold them fast till they vegetate. The capsule of the beard of wild oats are twisted, and dislodge their seeds on wet days, when the ground is best fitted to receive them. Hence one of these, with its adhering capsule or beard fixed on a stand, serves the purpose of an hydrometer, twisting itself more or less according to the moisture of the air. The awn of barley is furnished with stiff points, which, like the teeth of a saw, are all turned towards one end of it; as this long awn lies upon the ground, it extends itself in the moist air of night, and pushes forward the barley-corn which it adheres to; in the day it shortens as it dries; and, as these points prevent it from receding, it draws up its pointed end, and thus creeping like a worm will travel many feet from the parent stem.

The MISTLETOE never grows upon the ground; the foliage is yellow, and the berries milk white; the berries are so viscous as to serve for bird-lime, and when they fall adhere to the branches of the tree on which the plant grows, and strike root into its bark, or are carried to distant trees by birds. The *Tellandsia*, or Wild Pine, grows on other trees, like the Mistletoe, but takes little or no nourishment from them, having large buckets in its leaves to collect and retain the rain-water. The mosses which grow on the bark of trees take much nourishment from them; hence it is observed, that trees which are annually cleared from moss by a brush grow nearly twice as fast.

The HOLLY is one of those winter shrubs which, like many animals, are furnished with arms for their protection; these are either aculei, prickles, as in the rose and barberry, which are formed from the outer bark of the plant; or spinæ, thorns, as in hawthorn, which are an elongation of the wood, and hence more difficult to be torn off than the former; or stimuli, stings, as in the nettles, which are armed with a venomous fluid for the annoyance of naked animals. The shrubs and trees which have prickles or thorns are grateful food to many animals, as gooseberry and gorse; and would be quickly devoured if not thus armed; the stings seem a protection against some kinds of insects, as well as the naked mouths of quadrupeds. Many plants lose their thorns by cultivation, as wild animals lose their ferocity; and some of them their horns. A curious circumstance attends the large hollies in Needwood forest; they are armed with thorny leaves above eight feet high, and have smooth leaves above, as if they were conscious that horses and cattle could not reach their upper branches.

The BOX-TREE, class *monoecia*, order *tetrandria*, has stamens and pistils in separate flowers, but on the same plant. The calyx of the staminiferous flowers consists of three leaves, the corolla of two petals, and the rudiment of an imperfect germ. The pistilliferous flowers have a four-leaved calyx, three petals to the corolla, three styles, and a three-celled capsule, terminated by three beaks, and having two seeds in each cell; the flowers of both spring in bunches from the axils of the leaves or branches. Dutch Box is commonly used for bordering of flower-beds; but box-wood is extremely hard and smooth, and not being apt to warp, combs, mathematical instruments, knife-handles, and button-moulds, are made of it. In the south of Europe it is cultivated in gardens, and kept in flower-pots, with as much care as we preserve myrtles.

LICHENS. The most remarkable and important of this genus is the *islandicus*, or eatable Iceland lichen, which grows on many mountains of Scotland. It consists of nearly erect leaves, two inches high, stiff when dry, but soft and pliant when moist, variously divided without order into broad distant segments, bifid or trifid at the extremities. The upper, or interior surface of the leaves, is concave, chesnut colour, smooth, and shining, but red at the base; the under or exterior surface is smooth and whitish, a little pitted, and sprinkled with very minute black warts. The margins of the leaves, and all the segments from bottom to top, are ciliated with small, short, stiff, hair-like spinules, of a dark chesnut colour, turning towards the upper side. The shields are very rarely produced.

The LICHEN *(rangeferinus)*, has a slight flavour of turpentine, eats something like a lettuce, and its internal part is as endive, but white as snow. It flourishes where trees have been destroyed by conflagration; and the reindeer dig in the snow for it; being so highly nutritive and agreeable to their palates, as to be both meat and drink to them. On this lichen, at the limit of the arctic circle, feeds a breed of cows, so small that they are only the size of sucking calves. The milk they give is of a very fine and rich quality, almost all cream; sweet and delicious, and so thick, that it draws out in strings.

Archil is a whitish moss, which grows upon rocks, in the Canary and Cape Verd Islands, and yields a rich purple tincture, extremely beautiful. This weed is imported as it is gathered. Those who prepare it for the dyer grind it betwixt stones, so as to thoroughly bruise, yet not reduce it into powder; and then moisten it occasionally with a strong spirit of urine, or urine itself, mixed with quicklime; in a few days it acquires a purplish red, called Archil, and at length a blue colour, Laemus or Litmus.

The LIVER WORT is the first plant that vegetates on naked rocks, covering them with a kind of tapestry, and draws its nourishment perhaps chiefly from the air; after it perishes, earth enough is left for other mosses to root themselves; and, after some ages, a soil is produced sufficient for the growth of more succulent and large vegetables: in this manner, perhaps, the whole earth has been gradually covered with vegetation, after it was left by the ocean.

There has been a dispute whether the FUNGUSSES should be classed in the animal or vegetable department. Their animal taste in cookery, and their animal smell when burnt together, with their tendency to putrefaction; and, lastly, their growing and continuing healthy without light, as the lecoperdon tuber, or truffle, and the fungus vinosus, or mucor, in dark cellars, and the esculent mushrooms on beds covered thick with straw, would seem to shew that they approach towards the animals, or make a kind of isthmus connecting the two mighty kingdoms of animal and of vegetable nature.

The principal FRUIT-TREES and SHRUBS of Britain consist of different varieties of the Apple, the Pear, the Plum, the Gooseberry, the Currant, the Mulberry, the Raspberry, the Peach, Nectarine, and the Apricot, Fig, Vine, Quince, and Medlar; besides Walnuts, Filberts, and small Nuts, and other hedge produce.

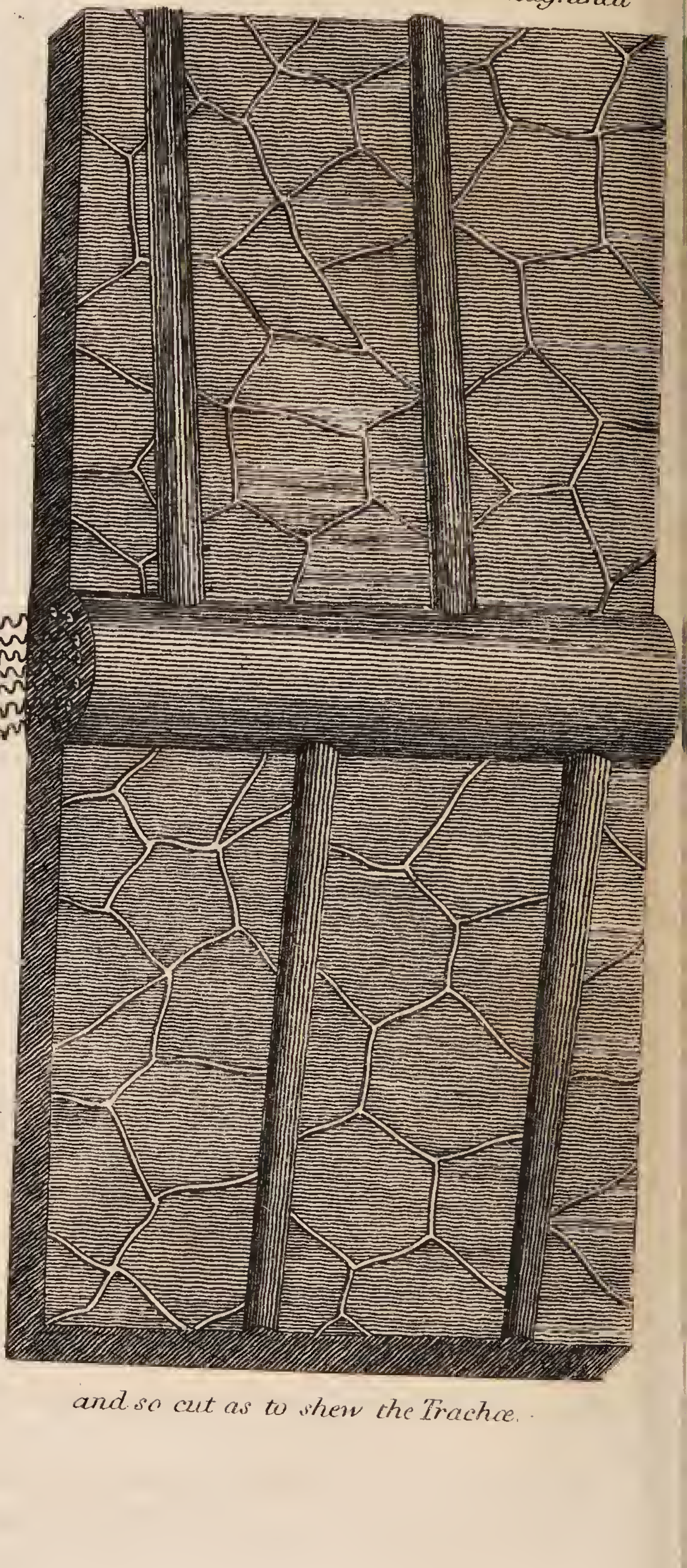
Linnæus classes the APPLE, PEAR, and QUINCE, under the common pyrus, as a genus of the *pentagynia* order and *icosandria* class; the *calyx* is *quinquefid* class, and there are five petals. The species are the *malus*, or Common Apple Tree, and the *communis* or Pear Tree, and the *cydonia*, or Quince, so called from a town in Crete, where it is much cultivated. The size and form of these trees are so well known as to require no description to the British reader.

The botanical nomenclature, under the name *prunus*, includes the various PLUM Trees known to our gardens, the Wild Plum, or Bullice Tree, the Black Thorn, or Sloe Tree, the *cerasus* or Cherry Tree, and the *armeniaca*, or Apricot Tree; they are referred to the order *monogynia*, and to the class *icosandria*, of which there are fifteen known species, of which the above are part: these trees, their fruit and management, are so well known, and are treated of in so many common books, that a detailed notice of them is unnecessary.

The PEACH and NECTARINE of our gardens is known in the Linnæan arrangement under the name of *amygdalus*, and is of the order of *monogynia*, and classed *icosandria*, ranking under the thirty-sixth natural order; the chief species are the Almond, the Peach, and the Nectarine. Of the Peach, from thirty to forty varieties are in cultivation; and of the Nectarine, ten or twelve; the perfection to which they are brought renders them the best-flavoured fruits of their

Soap Tree

Part of the leaf of the Vine magnified



and so cut as to shew the Tracheæ.

Papyrus Plant

kind grown in any part of the world. For information, relative to their particular qualities and treatment, we refer to practical books of horticulture.

The Mulberry Tree, or *morus*, is a genus of the *tetrandria* order, belonging to the *monœcia* class, and there are seven species, four of which are cultivated among us, viz. the *nigran*, or black, the *alba*, or white, the *papyrifera*, or paper mulberry, and the *rubra*, or red Virginia sort. This tree in England is cultivated for its delicious fruit; but, in the south of France, Italy, and some other parts of the world, the *alba*, or white species, is of great value, as affording food to the silkworm in silk countries; therefore, vast plantations of these trees are established, and their successful cultivation is an object of great importance; they were first planted in England in the reign of James the First, and hopes were entertained that silk might have been produced sufficient to serve for our domestic consumption; but the experiment has not been sufficiently made.

The VINE, known in botany under the name *vitis*, is a genus of the class *pentandria* and order *monogynia;* there are eleven species, and an immense number of varieties; in England they are cultivated chiefly against the sides of walls, chiefly for their fruit; and those grown in hot-houses yield to none in the world in size and flavour; but, in countries where they are cultivated for wine, dwarf sorts are preferred; and the vineyards, particularly in France, resemble our plantations of raspberry trees; and, like them, are cut down on the approach of winter. Ancient records and traditions lead to the belief that the vine was more cultivated in ancient times in Britain than at later periods, and that much wine was made from vineyards, particularly in the southern and western counties; at present, the grape-wine of England is not superior to that which is made from the gooseberry and currant.

The female flowers of the Melon have no stamina or summits, but have a very large oval germen, situated below the flower, which turns to an oval fruit with several cells, filled with oval, acute-pointed, compressed seeds, inclosed in a soft pulp. Great variety of this fruit is cultivated in different parts of the world, many of no value, size being regarded in the markets. The *Canta-*

leupe melon, so called from a place near Rome, where this fruit has been long cultivated, and whither it was brought from Armenia, is in the greatest esteem among the curious in every part of Europe. There are also the *romana*, the *succado*, the *Zatte*, the small *Portugal* or *dormer*, the rock and the *Galloway* melons. In France, melons are eaten almost in the same profusion as bread.

The COMMON RED CURRANT-TREE, &c. (*rubrum*,) has a shrubby stem, dividing low into many branches, forming a bushy head, five or six feet high or more, without thorns; broad trilobate leaves, and smooth pendulous clusters of greenish flowers, succeeded by small clusters of berries.

It grows naturally in woods and the edges of most parts of Europe, and comprises all sorts of red and white currants. The *ribes rubrum*, or common red currant, being the parent, from which the seed of all the others were first obtained, and improved by culture.

The BLACK CURRANT-TREE, (*nigrum*,) has a shrubby stem, dividing low into many branches, forming a bushy head five or six feet high; broad trilobate leaves of a rank odour, and having racemous clusters of oblong greenish flowers, succeeded by thin clusters of black berries.

The COMMON GOOSEBERRY-BUSH, (*grassularia*,) rises with a low shrubby stem, dividing low into a very branchy bushy head, armed with spines; trilobate smallish leaves, having hairy ciliated footstalks; and small greenish flowers, succeeded by hairy berries; and consists of many varieties, of different sizes and colours.

The PRICKLY-FRUITED GOOSEBERRY-BUSH, (*cynosbati*,) has a shrubby stem and branches, armed with spines, mostly at the axillas, and prickly fruit in clusters.

All the above species of ribes, both currant and gooseberry kinds, the hardy shrubs, that prosper anywhere in open or shady situations, and in any soil; bearing plentifully in any exposure, though in open sunny situations they produce the largest and fairest fruit, ripening to a rich vinous flavour; but it is eligible to plant them in different situations and aspects, to have the fruit early and late.

There is an obvious connexion between the kind of foliage and the kind of fruit in many of our orchard and garden-trees; and although the full and true uses of the leaves of vegetables are not well understood, yet the subject seems open to research, and even now capable of practical applications. The first remarkable coincidence is, between the size of the leaves and fruit. This may be seen, in contrasting the fruit and leaves of the *Magnum-bonum* plum, the *Damascene*, the *Bigarreau*, and the wild cherry; the *Cadillac* and the little musk-pear; the yellow Antwerp and the red prickly-raspberry; the several varieties of the gooseberry; the common small walnut and the large or double walnut; the large and small medlar; the different species of cranberries; the filbird and the hazel-nut. And the same indications prevail in herbaceous fruit-bearing plants; as in the melon and gourd, and the strawberry; and among esculent vegetables, as in the pea and bean.

The STRAWBERRY-TREE, or *arbutus unedo*, is a native of Italy, Spain, and Ireland. It flowers about November or December.

LECTURE LXXXIII.

FLOWERS.

Go, mark the matchless workings of the Power
That shuts within the seed the future flower;
Bids these in elegance of form excel,
In colour these, and those delight the smell;
Sends Nature forth, the daughter of the skies,
To dance on earth, and charm all human eyes.

FLOWERS may be considered as the pride and glory of the earth, and the most beautiful display of Creative Power in the vegetable kingdom, and they are with the poets as the lovely attendants of spring, inexhaustible sources of illustration. They gratify at once the senses of sight and smell, and fill the mind with wonder and delight. In the beauty of the rose, you may contemplate the loveliness of virtue; and in the lily of the valley, modestly peeping forth from her green mantle, and shedding the sweetest fragrance in retirement, the endearing nature of true humility.

These beauteous products of Nature do not appear all at once, but in the most provident regularity of succession. Each month displays beauties peculiar to itself. To the *tulip*, the transient glory of the garden, succeeds the *anemone*, encircled at the bottom with a spreading robe, and rounded at the top, into a beautiful dome; and the *ranunculus*, which displays its are magnificence of foliage, and charms the eye with its brilliant assemblage of colours. The *rose*, the favourite flower of poets, there glows with its own vivid tints, and diffuses around its aromatic sweets; followed by the *carnation*, which centering in itself the perfection of every flower, next attracts the observer, by the lustre and variety of its hues, and by that fragrancy of scent, which entitle it to pre-eminence over the most beautiful of the flowery tribes.

The impression, says the pleasing author of the Wonders of the Vegetable Kingdom, made by flowers upon the mind, seems connected with some moral feeling; and there are many which create a sentiment of cheerfulness, and others of melancholy. Thus the yellow-green, which nature assumes at the falling of the leaf, was worn in chivalry as the emblem of despair; brown is considered indicative of sorrow; red, of anger; and green, of tranquillity. The violet is acknowledged as an emblem of retiring merit; the lily, of innocency; the aloe, of constancy; the rose, of beauty and command; and the palm and laurel, of victory and honour.

In India, the *pichula* blossoms during the rainy season, and, with the asclepius winding round it, form a most lovely botanical picture. The *camalata* is so beautiful in its colour and form, and has a scent so delicately exquisite, that eastern poets fable it to have scented Paradise. The *alimucta*, ‘ the delight of the woods,’ because of the beauty and fragrance of its flowers, is a gigantic climber; but when it meets not with a stem to grasp, it assumes the form of a sturdy tree, whose highest branches display aloft their natural flexibility and aptitude to climb. The *capittha* is noticed by Sir W. Jones; and he says, “ this singular fact may, indeed, have been accidental; not a single flower, out of hundreds examined, had both perfect germs, and anthers visibly fertile; while others, on the same tree, and at the same time, had their anthers profusely covered with pollen, but scarce any styles, and germs to all appearance abortive!” The *d’urva* is the sweetest and most nutritive pasture for cattle; and its beauty is such, that its flowers, in their perfect state, are among the loveliest objects of vegetable nature, and through a lens appear like very minute rubies and emeralds, in constant motion from the least breath of air.

In Mexico, the *cheianthodeadron* bears a flower which, prior to expansion, resembles the closed hand, and subsequently the open hand of a monkey. Not long ago there existed only one known specimen, which grew, and has for many ages flourished, in Toluca, where some botanists took slips in 1787, and planted them in the royal garden at Mexico, where one took root, and, in 1804, was forty-five feet high.

The Chili plant, *flower of the air*, is so called because it has no root, and is never fixed in the earth. It twines round a dry stock; each shoot producing two or three flowers like a lily, white, transparent, and odoriferous. It can be transported 300 miles, and vegetates during the time, while suspended on a twig.

The entomologist boasts that there is nothing analogous in the vegetable world to the metamorphosis of the butterfly. But turn the eye to the Oriental poppy, just beginning to expand. The corolla is carefully folded up in a rough unvaried cover of green. In this state it is not particularly attractive; but wait a few moments, till the sun has absorbed the dews of night, and dried and warmed the rough green envelope of the head. Suddenly it opens, and falls off. As the butterfly bursts from its dull dry case in all the pride of perfection, so does this brilliant flower instantly display its rich brown stamens, and unfold its brilliant orange petals. In both the insect and the flower, nature seems to have deviated from her usual slow gradations, as if impatient for, and glorying in, their charms.

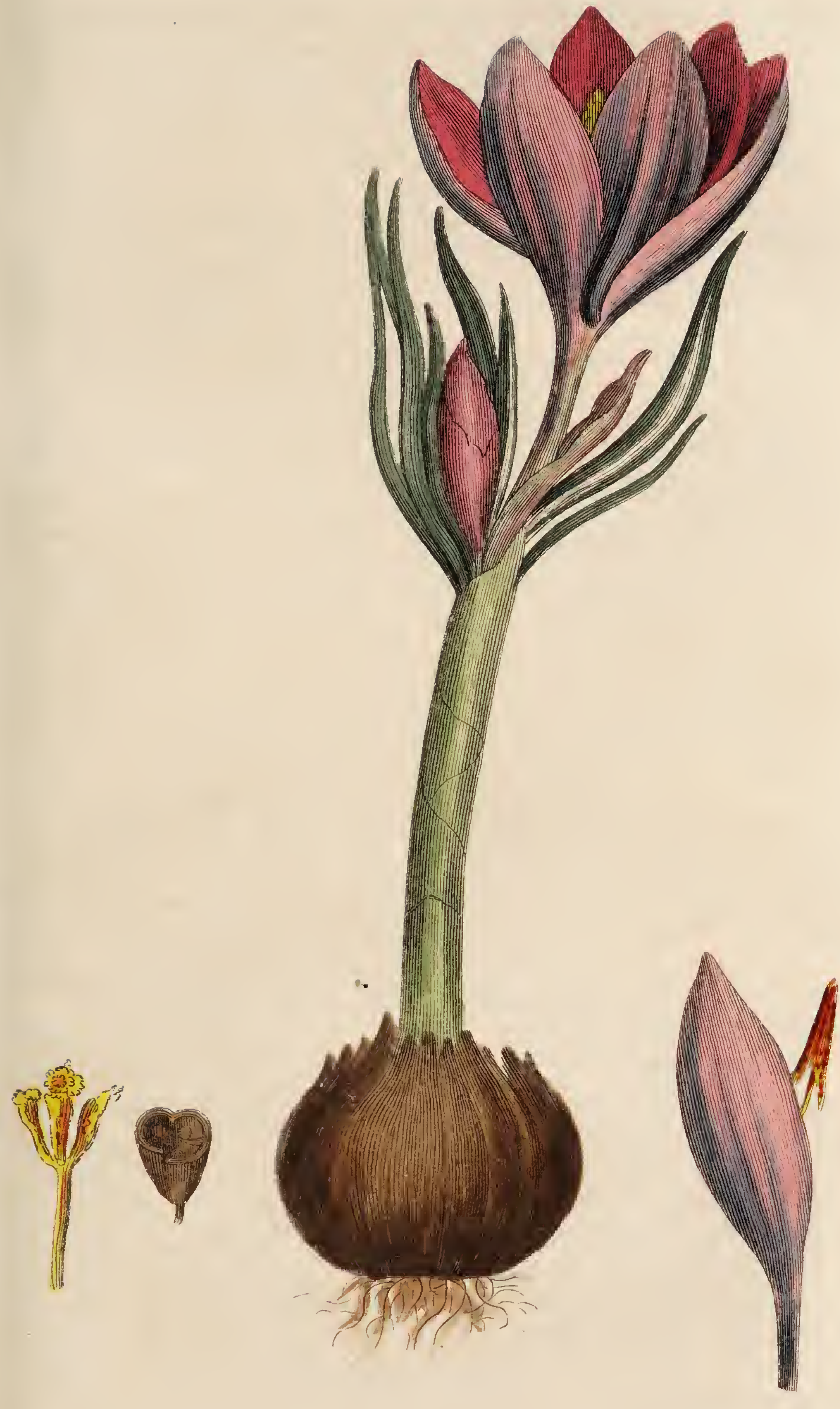
Thomson gives the following picturesque recapitulation of the flowery world:—

> Along these blushing borders bright with dew
> And in yon mingled wilderness of flowers,
> Fair-handed Spring unbosoms every grace;
> Throws out the snowdrop and the crocus first;
> The daisy, primrose, violet darkly blue,
> And polyanthus of unnumbered dies;
> The yellow wall-flower, stained with iron-brown;
> And lavish stock that scents the garden round;
> From the soft wing of vernal breezes shed,
> Anemonies; auriculas, enriched
> With shining meal o'er all their velvet leaves;
> And full ranunculus of glowing red.

Then comes the tulip race, where Beauty plays
Her idle freaks, from family diffused
To family, as flies the father-dust,
The varied colours run; and, while they *break*
On the charm'd eye, the exulting florist marks,
With secret pride, the wonders of his hand.
No gradual bloom is wanting; from the bud,
First-born of Spring, to Summer's musky tribes:
Nor hyacinth, of purest virgin white,
Low bent, and blushing inward; nor jonquils,
Of potent fragrance; nor Narcissus fair,
As o'er the fabled fountain hanging still;
Nor broad carnations, nor gay-spotted pinks;
Nor showered from every bush, the damask-rose
Infinite varieties, delicacies, smells,
With hues, on hues expression cannot paint
The breath of Nature, and her endless bloom.

The odours of many flowers, so delightful to our sense of smell, as well as the disagreeable scents of others are owing to the exhalations of their essential oils. These essential oils have greater or less volatility, and are all inflammable; many of them are poisonous, as those of laurel and tobacco; others possess a narcotic quality, as is evinced by the oil of cloves instantly relieving slight tooth-aches; from oil of cinnamon relieving the hiccup; and balsam of Peru relieving the pain of some ulcers. They are all deleterious to certain insects, and hence their use in the vegetable economy being produced in flowers or leaves to protect them from the depredations of their voracious enemies. The shops of medicine are supplied with resins, balsams, and essential oils; and the tar and pitch for mechanical purposes are produced from these vegetable secretions.

Flowers are—*Salver-shaped:* having one petal, lower part tubular, upper flat, expanded; periwinkle; mouse-ear; scorpion-grass.—*Bell-shaped:* lily of the valley; hare-bell; Canterbury-bell.—*Tubular bell-shaped:* honeysuckle.—*Bell,* or *pitcher-shaped:* but distended in the middle; arbutus.—*With six reflected segments:*—hyacinth; white lily.—*Wheel-shaped:* common speedwell.—*Funnel-shaped:* cowslip.—*Gaping blossom:* so called from the resemblance to a gaping mouth, when squeezed on both sides: snapdragon.—*Cross-shaped:* gilliflower; candy-tuft; cabbage.—*Butterfly-shaped:* (papilionaceous,) from an



Crocus Sativus _ Saffron Crocus.

Neele & Son 352 Strand

London Published by Sir B. Phillips & C°. Feb. 10. 1823.

imaginary resemblance to that insect.—Pea; broom. The component parts are the standard, wings, and keel. The keel is generally green, enclosing the stamens; the wings wrap over the keel; the standard unfurls above, and gives a distinguishing character and beauty to the whole.

When a blossom is furnished with both calyx and corolla, it is termed *(flos completus)* a complete flower; when the latter is wanting, *(incompletus ;)* when the former, *(nudus)* naked.

When the stamens and pistils are included in one flower, it is called perfect or united; when in different flowers of the same plant, they are called separated flowers, (monœcious, as confined to one house or dwelling;) as in the birch, cucumber, melon. If the stamens and pistils grow on separate roots, they are termed dioicous; as the yew and strawberry. A compound flower consists of many florets, upon one receptacle, and included within one common calyx; as most of the *syngenesia* class. Sometimes the flowers which grow in umbels, are called compound; as those in the second order of the class, *pentandria.* A real compound flower has the anthers united like a cylinder, with a single seed upon the receptacle under each floret.

Florets are either tubular, cloved into five parts at the border; as the tansie; or narrow, the blossom long and strap-shaded, as the dandelion. In the daisy and sun-flower, the central florets are tubular, and those in the circumference narrow, or radiate.

In the second order of the class *pentandria*, containing umbelliferous plants, the flowers composing the umbels are each formed of five petals. When the petals have the same size and shape, the florets are equal; as angelica and celery; but when the outer petals are larger than the others, the florets are radiate; as carrot.

A flower is aggregate, when several florets, each with a distinct calyx, form one compound flower; all either within one common calyx, or upon one common receptacle; so that none can be taken away without destroying the uniformity of the whole; as the flowers of thrift, teasle, parsley, scabious, and daisy.

The CACTUS, GRANDIFLORUS, or CEREUS, is a native of Jamaica and Vera Cruz; it expands a most quisitely beautiful corolla, and emits a most fragrant odour for a few hours in the night, and then closes to open no more. The flower is nearly a foot in diameter, the inside of the calyx of a splendid yellow, and the numerous petals of a pure white: it begins to open about seven or eight o'clock in the evening, and closes before sun-rise in the morning. The *cistus labdaniferus*, and many other flowers, lose their petals after having been a few hours expanded in the day-time; for in these plants the stigma is soon impregnated by the numerous anthers: and there is no further occasion for the corolla to protect them. In many flowers of the *cistus labdaniferus* I observed two or three of the stamens were perpetually bent into contact with the pistil. The *nyctanthes*, called Arabian jasmine, is another flower which expands a beautiful corol, and gives out a most delicate perfume during the night and not in the day, in its native country, whence its name: botanical philosophers have not yet explained this wonderful property; perhaps the plant sleeps during the day, as some animals do; and its odoriferous glands only emit their fragrance during the expansion of their petals; that is, during its waking hours; the *geranium triste* has the same property of emitting its fragrance only in the night. The flowers of the *cucurbita lagenaria*, are said to close when the sun shines upon them. In our climate many flowers, as tragopogon and hibiscus, close their flowers before the hottest part of the day comes on; and the flowers of some species of cucubalus and silene, viscous campion, are closed all day; but, when the sun leaves them, they expand and emit a very agreeable scent, whence such plants are termed *noctiflora*.

Some of the bell-flowers close their apertures at night, or in rainy or cold weather, as the convolvulus; and thus protect their included stamens and pistils. Other bell-flowers hang their apertures downwards, as many of the lilies; in those the pistil, when at maturity, is longer than the stamens; and, by this pendant attitude of the bell, when the anthers burst their dust falls on the stigma; and these are, at the same time, sheltered as with an umbrella from rains and dews. But, as a free exposure to the air is necessary for their fecundation, the style and filaments in many of these flowers continue to grow longer after the bell is open, and hang down below its rim. In others, as in the martagon, the bell is deeply divided, and the divisions are reflected upwards, that they may not prevent the access of air, and, at the same time afford some shelter from perpendicular rain or dew. Other bell-flowers, as the hemerocallis and amaryllis, have their bells nodding only as it were, or hanging obliquely towards the horizon; which, as their stems are slender, turn like a weathercock from the wind, and thus very effectually preserve their inclosed stamens and anthers from the rain and cold. Many of these flowers, both before and after their season of fecundation, erect their heads perpendicular to the horizon, like the meadia, which cannot be explained from mere mechanism.

Trumpet-shaped flowers convey as much heat as possible to the interior; and it is, therefore, very remarkable that this configuration is generally given to those which grow among high grass, or under the shade of trees. Such is the structure of the *convolvulus*, which may be termed a semi-ephemeral flower; for it seldom, indeed, continues more than half a day; and when the purposes of its transient duration are completed, the border contracts inwardly, and furls itself up like a purse. The shape of the *convolvulus sepium*, or great bind-weed, is singularly elegant: it resembles an ivory trumpet, and not unfrequently covers the trunks of aged trees, in moist situations, with its broad and ample leaves.

Corollas seem designed to catch the rays of the sun, and, therefore, are divided into separate petals, which may be compared to an assemblage of highly-polished mirrors, directed to one focus; but when the situation of the plant renders it necessary that the heat should be as much dissipated as possible, the petals are placed in such a manner as to preclude any reflection from their polished surface on the interior of the flower, and no additional heat is conveyed. This is particularly conspicuous in the *lilium album*, or white lily. Notwithstanding the large size, and dazzling whiteness of the corolla, it expands and disperses the heat of the sun. The lily rears its head, the empress of the garden.

The WILD EUROPEAN TULIP, (*sylvestris*,) has an oblong bulbous root, sending up long narrow spear-shaped leaves; and a slender stalk, supporting a small yellow flower, nodding on one side, with acute petals.

Gesner's Turkey Tulip, or Common Garden-Tulip, (*gesneriano*,) has a large, oblong, tunicated, solid, bulbous root, covered with a brown skin, sending up long oval spear-shaped leaves; an upright, round, high stalk, garnished with a few leaves, and its top crowned with a large bell-shaped erect hexepetalous flower, of various colours and variegations.

This tulip, in its varieties, is generally cultivated to ornament gardens, and is admired by all for its great variety and beauty of appearance; it grows in the open ground, in any common soil of a garden, and decorates the beds and borders of the pleasure-ground, for six weeks or two months in spring, by different plantings of early and late sorts; the principal part in autumn, and the others in January and February. The autumn plants will come earliest into bloom, and flower the strongest: and the others will succeed them. In summer, when the flowering is past, and the leaves and stalks assume a state of decay, the bulbs of the choicest varieties are taken up, the offsets separated, and the whole cleaned from filth; then put up to dry till October or November, and then planted again for the future year's bloom.

By cautiously cutting in winter through the concentric coats of a tulip-root, longitudinally from the top to the base, and taking them off successively, the whole flower of the next summer's tulip is beautifully seen by the naked eye, with its pearls, pistils, and stamens. The flowers exist in other buds in the same manner as in hyacinths, but the individual flowers of these being less, they are not so easily dissected or so conspicuous to the eye.

The retiring of the tulip to its hybernacle, or winter lodge, is thus beautifully described:

> When o'er the cultur'd lawns and dreary wastes
> Retiring Autumn flings her howling blasts,
> Bends in tumultuous waves the struggling woods,
> And showers their leafy honours on the floods,
> In withering heaps collects the flowery spoil,
> And each chill insect sinks beneath the soil:
> Quick flies fair Tulipa the loud alarms,
> And folds her infant closer in her arms;
> In some lone cave, secure pavilion, lies,
> And waits the courtship of serener skies.—
> So, six cold moons, the dormouse charmed to rest,
> Indulgent sleep! beneath thy elder breast,
> In fields of fancy climbs the kernelled groves,
> Or shares the golden harvest with his loves.—Darwin.

The NIGHT-SCENTED GERANIUM: class, *monadelphia;* order, *decandria;* has filaments united; ten stamens. The flowers of this genus are distinguished by a permanent calyx of five small oval leaves, a corolla of five oval or heart-shaped petals; in some species equal, in others the upper two are much larger than the three lower ones; ten stamens terminated by oblong summits, and a permanent five-cornered germen, which contains five seeds, each of which is terminated by a tail, and wrapped up in the husk of a beak, where they are twisted together at the point, so as to resemble a stork or crane's beak. There are upwards of eighty species, and the most beautiful have been transported from the Cape of Good Hope. The *geranium triste* grows about a foot high; from the stalks arise two or three small sessile leaves, from whence proceed two or three naked peduncles, bearing an umbel of yellowish flowers, marked with dark purple spots, and smelling very sweet after sunset.

BEE-FLOWER. One species of the orchis has, in appearance, a correct resemblance to the bee sipping honey, in a spot on the breast of the flower.

> See on that flower's velvet breast,
> How close the busy vagrant lies!
> His thin-wrought plume, his downy breast,
> Th' ambrosial gold that swells his thighs!
> Perhaps his fragrant load may bind
> His limbs; we'll set the captive free;
> I sought the living bee to find,
> And found *the picture of a bee.* LANGHORNE.

The Orchis flowers in June, and is found principally on hilly grounds and near woods; but it is never seen in perfection except when it grows in the shade of a wood, as in this situation it escapes all those injuries which the leaves are apt to suffer when growing in too sunny exposure. So striking is the general resemblance which the flowers, when viewed at a little distance, bear to an insect, as to have uniformly impressed all observers with the same idea; and may almost justify the application of the epigrammatic description.

> Nature in doubt—a beauteous flow'r
> Or insect to disclose,
> At length beneath her forming pow'r,
> They both in union rose.

The CHINA ROSE: class, *monadelphia;* order, *polyandria;* has stamens united, many pistils. This genus is distinguished by a double calyx, the exterior of which is polyphyllous; the flowers are bell-shaped and of various colours, and the capsule has five cells, containing many seeds. *Hibiscus rosa Sinensis*, or Chinese rose, is a native of the East Indies; it has a woody stem, and ovate sharp-pointed leaves, serrated at the edges; the colour and size of the flowers, when they are double, bear a strong resemblance to the rose. They are a beautiful ornament in Chinese painting and porcelain. This plant is cultivated by the inhabitants of India, who make use of its flowers on all occasions of festivity, and also in their sepulchral rites.

The PASSION-FLOWER, *(passiflora,)* is a native of warm countries; only one species is sufficiently hardy to succeed in the open air in this country.

The blue-rayed common palmated passion-flower, has long, slender, shrubby, purplish-green stalks, branchy, and ascending upon support by their claspers, 30 or 40 feet high; with one large palmated leaf at each joint, and at the axillas, from July until October, it is in flower; its large spreading flowers are very conspicuous, and their composition is exceedingly curious and beautiful, with whitish-green petals, and blue radiated nectarium; succeeded by a yellowish fruit. They are only of one day's duration, opening about 11 or 12 o'clock. Frequently in hot sunny weather they burst open with elasticity, and continue fully expanded all day: and the next they gradually close, assuming a decayed-like appearance, and never re-open; the evening puts a period to their existence, but they are succeeded by new ones daily on the same plant.

The PINK, or CARNATION: class, *decandria;* order, *digynia;* has ten stamens and one pistil; and is characterised by a cylindric monophyllous calyx, with four scales at the base; a corolla of five petals, and a cylindric one-celled capsule. It includes all the beautiful varieties of carnations, Chinese or Indian pinks, and Sweet Williams.

Plants, which attach themselves to others, are termed *parasitic;* and are divided into two classes, the ornamental and the injurious. The *caraguata*, a West-Indian plant, is a striking instance of the latter. It clings round the nearest tree, and, soon gaining the ascendency, covers the branches with a foreign verdure, robs them of nourishment, and at last destroys its supporter.

HEART'S-EASE: class, *syngenesia;* order, *monoga-*

mia, has anthers united and one pistil. The stems are diffuse, procumbent, and three-leaved; the leaves oblong, and cut at the edges; in its natural state it is found almost colourless, or of a pale purple, but cultivation has rendered it one of the richest beauties of the garden. It has various appellations, as wild pansy, heart's-ease, three faces under a hood, and love in idleness.

AQUATIC PLANTS, or those growing immediately under water, differ essentially from the productions of the woods and fields. The *Lycopus Europæus*, or lesser bladder-snout, is one of the most curious of our native aquatic plants. The vesicles at the root consist of thin transparent, tough, horny, and elastic membranes, each furnished with an aperture closed by a lid, which opens only outwards. Before the flowers appear, the vesicles are filled with water; but when the stalks erect themselves, and approach the time of flowering, the water disappears, and, instead, air is secreted; by which the plant rises to the surface, so that the flowers may unfold in open air. But, when the time of flowering is over, and the seeds are arrived at perfection, the vesicles again fill with the former fluid, and the plant sinks to the bottom.

The JASMINE: class, *diandria;* order, *monogynia;* has shrubby, long, slender stalks and branches rising upon supports fifteen to twenty feet high, with numerous white flowers, from the joints and ends, of a very fragrant odour. The corolla is inferior, regular, monopetalous, and salver-shaped, divided into five segments; the anthers are attached to the tube of the corolla; the pericarp is a berry of two cells, and the seeds are covered with a loose coat or aril. There are six species, the corolla of some of which is yellow. The flowers of the Catalonian jasmine are of a blush red without, and white within; and justly admired, as well as the entire shrub, for delicacy.

The VIOLET: class, *syngenesia;* order, *monogamia,* has five stamens united and one pistil. The flowers of this genus are simple; the calyx is divided into five parts, and the corolla consists of five petals, which are irregular, and terminate in a horn containing the nectary: and the capsule three-valved, with one cell placed above the valve. The *viola odorata*, or sweet violet, scents the banks, hedges, and borders of woods, with its fragrant purple flowers; it has no stalk, except the scape, which supports the flower, and the runners by which they are cultivated; the leaves are heart-shaped, and the corollas sometimes white; our gardens are adorned with a large double variety.

The species of orchis called FOOL-STONES, grow wild in England; but, for their extreme oddness and beautiful flowers, deserve a place in every garden. The orchis is assiduously cultivated in the East; and the root forms a considerable part of the diet of the inhabitants of Turkey, Persia, and Syria; forming the alimentary powder called SALEP; which is sold at five or six shillings per pound, though it might be furnished by ourselves at a sixth part of that price, if we attended to the culture of this plant.

The POLYANTHUS has thick fibrous roots, increasing into large bunches, crowned with a cluster of large oblong indented rough leaves; amidst them upright flower-stalks, six or eight inches high, terminated mostly by a cluster of several spreading flowers, of many different colours in the varieties. The principal are, purple, red, gold, orange-coloured, &c. They all flower beautifully in April and May; frequently again in autumn; and sometimes even in winter, if the season is mild.

The polyanthus is one of the noted prize-flowers among florists; many of whom have long been remarkably industrious, in raising a variety of different sorts; and in using every art to blow them with all requisite perfection; for, among the virtuosi, a polyanthus must possess several peculiar properties to be admitted in their collections. The chief properties required in a florist's polyanthus, are;—1. The stem or flower-stalk shall be upright, moderately tall, strong in proportion, and crowned by a good regular bunch of flowers, on short pedicles, strong enough to support them nearly upright. 2. The florets of each branch should be equally large, spreading open, flat, with the colours exquisite, and the stripes and variegations lively and regular. 3. The eye in the centre of each floret should be large, regular, and bright; and the antheræ, (by the florists called the *thrum*,) should rise high enough to cover the mouth of the tube or hollow part in the middle of the florets, and render them *thrum-eyed;* for when the style elevates the stigma above the antheræ, the eye of the tube appears hollow, showing the stigma in the middle, like the head of a pin, and is rejected as an incomplete flower, though its other properties be ever so perfect. This pin-eyed polyanthus, however, though rejected by florists, is the flower in its most perfect state, and great numbers of them are of as beautiful forms and colours as the thrum-eyed varieties.

The *Alpigena*, or HONEYSUCKLE, rises with a shrubby, short, thick, upright stem, branching strong and erect four or five feet high; large spear-shaped leaves, in pairs, opposite; and from the side of the branches many red flowers by two's on long footstalks, each succeeded by two red berries, joined at their base; it flowers in August, and the berries ripen in autumn. The *periclymenum*, or common climbing honeysuckle, hath two principal varieties; the English wild honeysuckle, or woodbine of our woods and hedges, rises with shrubby weak, very long slender stalks, and branches trailing on the ground, or climbing round any support; all terminated by oval imbricated heads, furnishing smallish flowers of white or red colours, and appearing from June or July till autumn; and the Dutch honeysuckle rises with a shrubby declinated stalk, and long trailing purplish branches, terminated by oval imbricated heads, furnishing large beautiful red flowers, of a fragrant odour, appearing in June and July. The *sempervirens*, or evergreen trumpet-flowered honeysuckle, rises with a shrubby declinated stalk, sending out long slender trailing branches, terminated by naked verticillate spikes, of long, unreflexed, deep scarlet flowers, very beautiful, but emitting little fragrance.

The *Cucubalus Behen*, or SPATTLING POPPY, is one of the prettiest decorations of the corn-field. The calyx is white, elegantly variegated with green or purple veins. The leaves, when boiled, have the flavour of peas.

There is something indescribably pleasing in the aspect of a corn-field before the harvest season. Flowers of various descriptions beautifully diversify the borders. Among these, the most conspicuous are the *scandix pecten*, or shepherd's needle, with its small white flowers, and long graceful tubes. The *convolvulus arvensis*, or small bind-weed, twining round the stalks of corn like a thirsis of living green; the *viola tricolor*, or hearts'-ease, that delicate little flower, which hides itself beneath the arching grain, and like true happiness dwells in concealment; the *agrostemma githago*, or corn-cockle, rising like a trumpet; the *scabiosa arvensis*, or field-scabious, with a tufted head; and the bright *centauria cyanus*, or corn-flower, strikingly contrasted with the rich brown ears of the corn.

The *achillea millefolium*, with cream-coloured flowers, jagged leaves, and yellow anthers, is finely contrasted with the bright scarlet of the *papaver rhœas*, or corn-poppy; from the petals of which the little *apis papaveris*, drapery-bee, chooses the hanging of her apartment. This curious insect dexterously cuts out the petals of the half-expanded flowers, straightens the folds, and fits them to its purpose, overhanging the walls of its solitary cell with this splendid tapestry, in which, when completely finished, and rendered soft and warm, it deposits honey and pollen.

The *Common Poppy* partakes in a small degree of the qualities of opium; but from the *papaver somniferum*, common in Norfolk, the greatest quantity of opium is extracted. Its effects are milder than the foreign, and agree better with many constitutions. From the seeds an oil is extracted, little inferior to the olive.

Opium is the milky juice of this plant, inspissated by the heat of the sun. It is exported from Turkey, Persia, Arabia, and different Asiatic regions. In the province of Bakar, especially, great attention is paid to the cultivation of the white poppy. Large fields are regularly ploughed for the reception of the seed, and aqueducts are erected for conveying water to every part. When the young plants approach the time of flowering, the greatest attention is paid to weeding them, and they are regularly watered to increase the juice. At the proper season for collecting opium, four or five incisions are made in the half-ripe capsules, taking care, however, not to pierce the internal skin. When this operation has been performed, the seeds are allowed to ripen. The incisions are always made in the evening, as the night-dews, by their moisture, favour the exstillation of the juice.

Hedera helix, or COMMON IVY. This interesting evergreen, to clothe in different language the eloquent sentiment of St. Pierre, "A friend to monuments and tombs, with which, in ancient times, the poets were crowned, sometimes covers with its foliage the trunks of the stateliest trees. It generally invests them when stripped by the hand of winter. Symbol of a generous friendship, it attaches itself to the wretched, and when death has smitten its protector, it restores him again to the honours of the forest; when he lives no longer, it causes him to revive, by decorating his branches with garlands of flowers, and festoons of undecaying verdure." The ivy has always been the friend of poets and moralists. Ivy has in all ages formed one of the characteristic emblems of fame and greatness.

The most elegant plant peculiar to bog-soil is the *Andromeda polifolia*, or marsh cistus, found in the north of England. The flowers are blood-red before they expand, but when full grown the corollas are of a flesh-colour. Scarcely is it possible for any painter's art to imitate so happily the beauty of a fine female complexion; still less could any artificial colour upon the face itself compare with the lovely hue of this captivating little flower.

The *Lycopus* is not altogether unlike the *Vallesneria*, so commonly found in the East-Indies, Norway, various parts of Italy, and abundantly in the Rhone. The roots are fixed at the bottom, whilst the flowers float on the surface of the water, and are furnished with an elastic spiral stalk, which extends and contracts as the water rises and falls; for frequently, from the rapid swell of the river by the mountain torrents, a variation occurs of many feet in a few hours.

The lower leaves of the *Ranunculus Aquatilis*, or water-crowfoot, grow under water, and are divided into minute capillary ramifications; whilst the upper spread, and have air-bladders in their foot-stalks to support them above the water. The leaves of land-vegetables perform the office of lungs, by exposing a large surface of vessels to the influence of air; aquatic ones also answer a similar purpose, like the gills of fish. As the materials necessary to life apparently abound much more in air than water, the sub-aquatic leaves of many plants are cut into fine divisions, to increase the surface; whilst those above the water continue undivided. It is equally remarkable, that the plants of lofty mountains have their upper leaves much more serrated than the lower, because the air is rarer, and a large surface of contact is necessarily required. Spring-water being nearly of the same degree of heat in all climates, aquatic plants, which grow in rills and fountains, are found equally in the torrid, temperate, and frigid zones.

LECTURE LXXXIV.

ON THE CLIMATES OF THE EARTH, AND ON THE DISTRIBUTION OF ORGANIZED PRODUCTIONS.

At one wide view God's eye surveys
His works in every distant clime;
He shifts the seasons, months, and days,
The short-lived offspring of revolving time;
By turns they die, by turns are born.
Now cheerful Spring the circle leads,
And strews with flowers the smiling meads;
Gay summer next, whom russet robes adorn,
And waving fields of yellow corn;
Then Autumn, who with lavish stores the lap of Nature spreads;
Decrepit Winter, laggard in the dance,
(Like feeble age opprest with pain)
A heavy season does maintain,
With driving snows, and winds, and rain;
Till Spring, recruited to advance,
The various years rolls round again. HUGHES.

CLIMATE is a result of Heat. Heat is derived from the Sun. The Sun, the fountain of heat and light, is a fixed body, and the Earth is a moving sphere. A fixed body heating a sphere must act principally on the parts of the rotundity which rise directly towards it; while the retiring parts acquire degrees of heat constantly diminishing. Such is the condition of the earth. It revolves on its axis, producing the phenomena of day and night; but only those parts which are directly opposed to, or successively nearest the heating sun, receive the entire heat; —all the rest decline or retire, so that the same quantity of solar rays which affect a certain space under the sun, are distributed over a larger space as the part is more or less oblique.

This will be obvious in roasting an apple suspended by a string from the stalk—the central, middle, or equatorial parts will be well roasted—while the upper and lower ends, or the north and south poles, will remain hard and scarcely warm, and the intermediate parts are affected more or less according to the distance. The parts well roasted are the torrid zone; the parts on each side, only half done, are the north and south temperate zones; and the top and bottom, which are unaffected, are the two frigid zones.

But the wisdom of the Creator, for the purpose of giving variety to the effect of the solar heat, and enabling it to operate on the whole, has so contrived the earth's motions, as that the same parts of the earth (or apple) shall not constantly be opposite to the sun (or fire), by causing the earth (or apple) in its orbit or course round the sun (or fire), to ascend and descend, or rise higher and fall lower; by which means it is evident the sun's (or fire's) rays will extend over each pole (stalk or bottom), and the pole's stalk and bottom are thus warmed and heated, while all the intermediate parts receive a varied temperature, as the earth (or apple) ascends or descends in its orbit.

We may now drop the humble, though exact comparison, and observe, that the space over which the sun is, by this contrivance, made to act directly is called the *torrid* zone, and dividing the arch from the equator to the poles into 90 parts or degrees, it extends 23½ of them on each side of the equator. Of course, when the sun is opposite 23½ degrees north or south of the equator, he shines 23½ degrees beyond each pole, and those parts for the time revolve in constant sunshine, or the contrary at the opposite season. This measure of 23½ degrees determines, therefore, the breadth of the arctic or north polar circle, and of the antarctic or south polar circle. The space around both poles, and the equal space of the torrid zone, or 94 degrees, deducted from 180 degrees, gives 43 degrees as the breadth of each of the two temperate zones.

But temperature is not uniform in the same latitudes. The effect of the solar heat is increased and accelerated by reflection and reiteration. Hence vallies are warmer than hills, and hills than mountains. The waters of the ocean absorb the solar rays and lower the local temperature, though the average which they acquire by intermingling, tends to maintain a greater equality in the surrounding air. Countries exposed also to winds blowing from cold regions, and others to winds from hot countries, have their average temperature respectively lowered or augmented.

The greater cold of the American continent is ascribed by Sir Richard Phillips to the following mundane cause. He remarks, that the breadths of two sextants of the globe is occupied by the dense mass of the old continent; that after an interval of nearly a sextant of sea, appears the new continent of one sextant in breadth;

and then an interval of sea takes place of two sextants. In the rotation of so unequal a mass the densest parts will describe the shortest time, or will revolve nearest the centre; consequently the two seas, and the small continent between them, will describe the longest line, or be farthest from the centre of gyration. Just like a lever with ten pounds at one end and nine at the other, when the arms in equilabre will be as nine and ten respectively. Hence, says he, the American continent revolves in a higher parallel of atmosphere than the old continent, and consequently in equal latitudes the one is colder and the other warmer.—Either this must be the fact, or the seas must rise in their centres to maintain the equilibrium.

The average effect of this change of inclination of the solar heat on the temperature of different parts of the earth's surface, has been determined by observation to be as in the following Tables:

M. Humboldt's Table of Average Temperature.

Latitude.	Corresponding months and seasons.	Mean temperature of the Month. Southern Hemisphere.	Mean temperature of the Month. Northern Hemisphere.
6°	December	95.0°	
15	June		95.5°
18	October		92
	April	94.5	
22	January		75
26	July	83	
	September		77
	March	75.5	
34	December		66
	June	62.5	
	February		70
	August	70	
43	July		73
	January	63.5	
48	June		71
	December	48	
58	July		62
	January	45	

Professor Leslie's Table.

Latitude.	Average Temperature at the surface. Fahrenheit.	Height. Perpetual Congelation of Feet.
0	84° 2′	15,207
5	83 8	15,095
10	82 6	14,764
15	80 7	14,220
20	78 1	13,478
25	74 9	12,557
30	71 1	11,484
35	67 0	10,287
40	62 6	9,001
45	58 1	7,671
50	53 6	6,334
55	49 2	5,034
60	45 0	3,818
65	41 3	2,722
70	38 1	1,778
75	35 5	1,016
80	33 6	457
85	32 4	117
90	32 0	0

Of the causes of variation, the most important is *elevation.* The thinness of the atmosphere, and the want of reflection, produces thus the same effect as is occasioned by distance from the equator, over the whole surface of the globe. Under the burning tropic, a height of 6000 or 8000 feet gives a temperature similar to that of France or Britain; while, at 13,000 or 14,000 feet, the climate is the same as under the Arctic circle; and all the summits which rise higher are clad in perpetual snow. Thus, above the glowing plains of Peru and Hindostan, vast regions of eternal ice are seen towering. Hence, along the great chains which traverse the tropical regions of Asia and America, the journey of a few days often transports the traveller through all the successive climates which diversify the terrestrial hemisphere; from the depth of polar winter above to the varied aspect and productions of the temperate regions, and at length down to all the varied luxuriance of tropical vegetation. These colossal ranges not only preserve, on their sides, a refreshing and salutary coolness; but, by the mighty rivers to which they give rise, diffuse fertility over remote and extensive countries. In the temperate climates, and in those approaching to the poles, where even the plains possess only that measure of heat which is requisite for fertility, mountains, even of moderate elevation, are almost always barren.

The greatest cold occurs when any country has a wide extent of sea to the south, and of land to the north or south. Such is the case with Greenland, which, in latitude 60° exhibits a more rigorous climate than Lapland, in latitude 72°. From the like cause, probably, the north-east extremity of Asia suffers a cold almost equally intense. A similar combination of circumstances, occurring to a certain extent, renders the climate of North America, under the same parallel, much colder than that of Europe; while in South America the promontory is cold because so narrow and unaided by the reflection of any adjacent land.

The tropical winds blowing from east to west across the heated continent of Africa, produces, on its western coast, a most intense heat, while in passing across the Atlantic they are considerably cooled; and though, in traversing South America, their temperature is again raised, yet, before reaching the opposite coast, they meet the tremendous snow-clad summits of the Andes, and are cooled.

The nature of the surface has also a striking effect upon the temperature of any range of country. A flat arid soil absorbs and retains the rays of the sun with extraordinary force. The vast desart of the Sahara, in Africa, becomes a species of furnace, which warms not only the contiguous regions, but great part of Europe and Asia. On the contrary, if the land is overgrown with woods, the motions of the solar rays are absorbed by the fluids in creating aqueous gas, instead of heating the dry air.

The causes of various degrees of heat in different zones of the earth being understood, it is not difficult to conceive that these zones present very different phenomena to the eye, in their animal, and vegetable productions;—but there are certain animals which thrive almost equally in all the zones, until the severity of the polar frosts chills them, or the hardened ground refuses subsistence. In this class, a beneficent providence has placed all those whose services, in a domesticated state, are most useful to man. These are the ox, the sheep, the hog, the goat, the horse, the dog, and the cat.

The torrid zone teems with the same rank luxuriance of animal as of vegetable life, the former depending on the abundance of the latter. The inundated meadows, and the banks of rivers, are covered with the most overgrown and gigantic forms. The mighty elephant here dwells in the depth of the ancient forests, while the rhinoceros and the hippopotamus roll their enormous bulk along the banks of the streams. Other wild animals, not marked by so huge a size, distinguish themselves by power and fierceness. The lion and the tiger extend little beyond the torrid zone. The same may be said of the leopard, the panther, the ounce, and the hyæna. This zone produces also some animals of striking beauty, and of a gentle and harmless character; the antelope, the zebra, the camelopard.

Desarts (says Bucke), from their expansion, sterility, privations, and unbroken silence, are eminently sublime and terrific. Those of America have a character producing a melancholy inadequately describable by language; and those of Africa and Asia affect the mind with more powerful emotions. A stillness, like that of the grave, pervades the whole scene from the northern horizon to that of the south. And while, in Guyana, the beast of the forest retire to the thickets, the birds to shelter beneath the foliage of trees, or the crevices of rocks; yet amid this apparent silence (says Humboldt), when we lend an attentive ear to the most feeble sounds transmitted by the air, we hear a dull vibration, a continual murmur, a hum of insects, that fill the lower strata of the air; thus proclaiming that all Nature breathes; and that under a thousand different forms, life is diffused through the dusty soil, as well as in the bosom of the waters, and in the air which circulates around us;—in Africa and Asia quantities of sand stretches from the east to the west; not a tree, nor a blade of grass, relieve the eye; the most awful exemplification of silence occurs; amplitude of space gives an amplitude to the mind; and a sublimity is imparted to the imagination, promising immortality to the soul.

The desart of Sahara equals in extent half of Europe, and presents the most frightful characters of sterility. The uniform gloom, and chaos, with a heat under which nature seems to sink, cause the most distressing and melancholy sensations. Here Adams travelled 29 days without seeing a single plant or a blade of grass! And Sidi Hamet traversed a different part 28 days, and witnessed similar sterility. Journeying to Tombuctoo, in a caravan, of 800 men, and 3000 camels, for ten days the ground was as hard as the floor of a house. In a subsequent journey with 1000 men and 4000 camels, they encountered the burning blasts of the desart, and for two days lay down with their faces to the ground. Two hundred camels and more than 300 men perished by the blasts. Here solitude and silence, are more horrific to the imagination, than ages of labour. The mighty mind of Napoleon felt the effect of such sterility. Crossing the desart to inspect the forts of Suez, he saw only one tree, and the ground was strewed with bones and bodies of men and beasts. The night was cold, no fuel was near; and his attendants collected the dry bones to make fires, whose warmth, with that of the cloaks whereon he reposed, served to invigorate the almost exhausted frame of the most extraordinary man in the records of history.

We were, Mr. Bruce says, (at a place called *Weadi al Halboub*) at once surprised and terrified by a sight surely one of the most magnificent in the world. In that vast expanse of desart, from W. and to N. W. of us, we saw a number of prodigious pillars of sand at different distances, at times moving with great celerity, at others stalking on with a majestic slowness. At intervals we thought they were coming in a very few minutes to overwhelm us; and small quantities of sand did actually more than once reach us. Again, they would retreat so as to be almost out of sight; their tops reaching to the very clouds. There the tops often separated from the bodies; and these, once disjoined, dispersed in the air, and did not appear more. Sometimes they were broken in the middle as if struck with a large cannon-shot. About noon they began to advance with considerable swiftness upon us, the wind being very strong at north. Eleven of them ranged along-side of us about the distance of three miles. The greatest diameter of the largest appeared to me at that distance as if it would measure ten feet. They retired from us with a wind at S. E. leaving an impression upon my mind to which I can give no name; though surely one ingredient in it was fear, with a considerable degree of wonder and astonishment.

The exuberance of phenomena, by which this zone is characterised, manifests itself also perniciously to man, by the swarms of the reptile species which it generates. Several of these are endowed with a force and magnitude so enormous, as even to surpass those displayed by the quadruped race. The boa constrictor, and other African species, are compared to the masts of the largest vessels and have been described as terrifying whole armies. The lizard tribe are equally gigantic and formidable; the crocodile, the alligator, the gavial, the caiman, fill all the great rivers of the torrid zone, and are ready to devour the unwary passenger.

The feathered creation are numerous, adorned with the most brilliant plumage, and utter sounds like the human voice: but they do not pour forth those melodious notes which charm the inhabitants of the temperate climates. Animals, as the ostrich, the cassowary, and the condor, display a magnitude rivalling that of quadrupeds, to whose form the two first bear a certain resemblance.

Even the insect tribe, in this world of life, exhibit themselves in numbers of which we can form no conception. Locusts, and even flies, assemble and move in such close and immense bodies, as to lay waste the earth, and drive nations before them. The tropical seas are also populous. The shark here displays a ferocity rivalling that of the wild beasts of the forest. All the fishes which shine with brilliant colours, and the flying fishes, to which air and water are alike, are peculiar to the seas of the torrid zone. The shell fish are larger than elsewhere. A race of marine insects are remarkable for the effects which they produce: These are the class of zoophytes; the corals, madrepores, and millepores, furnished with stony cases and appendages, which endure after the death of the animal, and which, gradually accumulating and adhering to each other, at length form large rocks, and even islands. The Pacific ocean, from New Holland to the Friendly islands, is entirely a coral sea, and navigators are in perpetual danger, even in the deepest water, of striking against rocks of this substance. New Holland is in a manner walled round with coral rocks, which are in a state of rapid growth, and have proved one chief source of the dangers encountered by recent navigators; yet these insects scarcely extend beyond the torrid zone.

Creation is moderate like the climate in the temperate zone.—The reptile race gradually diminish till they entirely disappear. The insect tribes bear no longer a harassing and destructive character. But, in the artic circle, the plains, deserted by man, are covered with the elk, the martin, the sable, the ermine, animals protected by nature from the cold with a covering of fur, at once rich and beautiful, and which is eagerly sought for by man for purposes of comfort and luxury. The rein-deer, a more valuable species, peculiar to this rigorous climate, serves all the purposes of a domestic animal, both for draught and food; yet even here, the short but violent heats of summer engender insects almost equal in number to those produced under the torrid zone. But the great scene of life in the Polar regions is the ocean. Here the enormous *Cetacea* rolls and mingles their roarings with the tempest. These noble beings display, in some respects, a conformation approaching to that of land animals, and many good affections. They have large bones, warm blood, milk with which the female nourishes her young, and organs of respiration. The whale is the longest lived of all animals, and it moves with great velocity.

In a word, the distribution of living bodies on the globe is not by chance; but accords in every department with the necessary harmony of cause and effect. The atmosphere, ocean, and earth, contain inhabitants adapted to such situations; each having a progressive order.

Insects and birds pass most of their lives in the air, and are peculiarly adapted for it by their organization. Breathing only the purest air, they seem to possess more exquisite sensations by more subtile organs, than the terrene animals. Yet the least humidity injures some species of insects; and water is injurious to many of the feathered tribes. Each have their peculiar place of residence, which determines not only the individual but all of the class. The gallinaceous tribes avoid wet places; belonging more to the earth than to the air, they travel little; and those which traverse the waters help themselves more with the wind than with their wings.

Nature has also peopled the waters, gradually from the inhabitants of the air. The heron and others similar, prefer the wet and reedy marshes, and only quit them when no longer habitable. The palmipede or web-footed, are more aquatic than aerial; and the gulls connect the tribes of ducks and divers, with the pelicans, cormorants, and penquins, which latter are nearer the fish than the bird.

The waters have peculiar organizations. The *algæ*, which grow in the sea; *fuci*, on the surface of the waves; *sagittaria*, *flurials*, *vallisneria*, which scarcely hold to the mud; reeds, water-lilies, and all aquatic plants, are less complete than the terrestrial vegetables. The crustacea are very peculiar insects; zoophytes, mere masses of organic bodies, belonging to all the three departments of nature indistinctly; mollusca, a pulpy mass of organization; the penquin, a degraded bird; the cetacea and amphibia, mutilated quadrupeds; and the fish itself, the mere dawn of a vertebral animal.

The crustacea and mollusca have to fish, the similar link which insects have to birds; they make in some degree the first preparation to the aliment which they draw from the mud, and from the putrified bodies. They are provided, like insects, with particular and accessory instruments which give every species a peculiar kind of life, and a distinct mode of action.

Fresh water contain small turtles, which during night graze on the banks; land turtle (tortoises) keep in damp places, earth themselves during the heats of summer, come forth in the cool part of the day, and lie torpid in winter. Salamanders, toads, and frogs, have analogous existence; winter stupifies them, spring awakens them, and the marshes resound with voices and croakings; even from places whence exhale putrid miasmata; the females deposit their spawn on the moss; the males fecundate it. But the cold suspends all animation; the reptile disappears in the mud; yet the integuments which cover the embryo, preserve it from injury during the winter.

Serpents prefer moist places. The savannahs of America, the deltas of the Nile, Ganges, and Indus, the thick forests which arrest the rays of the sun, are their habitation; quitting equally the frozen zones and arid desarts, they are not adapted for cold or drought, but for a warm and humid soil; and between the tropics we find the monstrous *boa*, and the venomous *rattle-snake*. The serpents of temperate countries never exceed a few feet, and *only* the viper among them is venomous. It is a remarkable fact, that certain countries, whose soil is wet and marshy, are devoid of hurtful animals, serpents, or toads. Ireland is thus privileged. In 1699, some frogs were thrown into the marshes, and multiplied considerably; but other reptiles, not able to bear the climate, perished.

The crocodile, cayman, and phocœ, live in society around the rocks, with the penguins. At the Malowin isles are sea lions, 25 feet long. The phocœ are polygaminous, the male appropriates a certain number of females, whom he obstinately defends against his rivals; and prior to parturition the whole family fix round some desart isle, and remain while the young require attention; they teach them to swim, seize their prey, struggle against the waves, and when thus educated, the whole of the affectionate and interesting family return to the open sea.

A family of *sea dogs* exists in the lake Baikal, in Siberia; the only known instance of such a fact; and supposed to be the remains of these which lived there when the sea bathed the Oural and Altai, and overrun Siberia.

The hippopotamus, almost immoveable on land, yet so agile in the waters, is found at the mouths of rivers on the Cape of Good Hope, and the Nile. The white bear is established on the polar ice, and with the phocœ catches fish in the high seas, and reposes on frozen snow; and the sea otter in the same region is insecure, his valuable skin and fur rendering him a prey to the boundless cupidity of man.

North-west of Upper Canada, in the lakes and marshes, are the residences of beavers, down to the 66° of latitude, but below, the savages do not even know them. They are sometimes seen on the borders of European rivers; but cultivation is now an impediment to their industry.

In the low and marshy plains, whence exhale unwholesome vapours, numerous plants absorb their deleterious gases, and imbibe these noxious properties, as water hemlock, &c. Swarms of sharp-stinged insects, voracious bats, and hoarse croaking birds, fly about in the foggy atmospheres; thousands of worms exist in the mud, and enormous reptiles drag themselves along the moving mass.

Inland, where fertile soil favours vegetation, grow trees, whose trunk, hollowed by the hand of time, is a hiding place for wild beasts. The oak, ash, elm, and beech, tower over multitudes of shrubs; the ivy and vine intertwist round the trunks; and the violet, primrose, and lily of the valley, peep through the bed of leaves just becoming mould; here are seen spring and delicate flowers only; mosses, lichens, and mushrooms, group at the foot of the trees, attach to their bark, and mark it with grey spots.

Great forests are found beyond the tracts of cultivation. In Europe, formerly they extended between the Rhone and the Seine; the Danube and the Rhine. The Gauls and Germans came there to hold their councils in silence; the Druid converted them into temples, and of the misletoe plant, cut from the top of the oak, he formed the religious palladium of these warlike tribes. They and their forests alike are now with the years before the flood. To the banks of the Missouri or the Ohio, we must resort to see forests in their native magnificence; containing the peaceable and frugivorous species; tapirs, peccaries, sagonins, sapajons, &c. The forests of the Old Continent abound between the tropics, in monkeys, elephants, rhinoceroses, babyroussas, wild boars, &c. and towards the north in innumerable nibblers. The carnivorous tribes skirt the forests, or the surrounding desarts; the conguars and jaguars in America; the lions and panthers in Africa; the tigers and jackals in Asia; and the wolves and foxes in Europe.

The immense plains of the Oronooka and Maranon are impenetrable, from vigorous vegetation. Monstrous trees fall with age, and are replaced by others; creepers as strong as cables are twined around them, and only give way to the planters clearing fires; beds of leaves cover the ground, and conceal venomous reptiles; and the whole mass is scarcely conceivable by any minds but such as have witnessed it. Long has the thick foliage prevented the solar rays from warming the ground; yet beneath this shade innumerable animals find a secure retreat and abundant food.

On the sandy and arid tracts, mix resinous and other trees; the maple and birch; the juniper and barberry, with the pine and cypress, the yew and cedar; moss and turf, fern, heath, cytisus, orchis, and broom, abound and resist the inclemency of the air. In temperate regions, woods skirt the mountains, and make them appear like green pyramids, whose whitened summits are lost in the clouds; they are found only in the plains of the boreal hemisphere.

Near the Pole vital influence is very limited; the cetacea, phocæ, and white bears, only subsisting; but towards the polar circle, quadrupeds abound; the isatis, fox, lynx, bear, glutton, martin, zibelline, and numerous nibblers. Here also is the rein-deer, the only resource of the Laplander in Europe, the Samoiede and the Tchoutski in Asia; replaced by the Caribon on the New Continent. Thus likewise is the elk by the orignal, the glutton by the carcajon, the weasel by the kinkajon, &c.

Too delicate! reproach no more
The seasons of thy native shore;
Could thy astonish'd eyes survey,
The Frigid Zone for five-months day;
Where, on an icy mountain's height,
Stern WINTER rests his ponderous weight,
While fields of ice to mountains piled,
Alone bedeck the trackless wild,
Our Winter would like infant seem,
Divested of his grandest gleam;
The direst Cold we Britons bear,
Equals the Arctic's vernal air.

The moss and lichen seem almost insensible to the influence of external agents; growing on bare granite and lumps of ice; ever preparing and announcing vitality; they are found in mines and caverns, at the bottom of thermal and mineral springs, under the pole, and in the torrid zone, on ruined monuments and polished marbles. Near the icy zone are ferns, creepers, and berry shrubs, as currants, rasps, and haws; after, come willows, birch, and stunted shrubs, with fields of grasses. A summer of a few days ripens rye and some legumes. The parts with northern exposure, are buried under snow; and those southward are covered with verdure. Similar are the productions on all high mountains of the earth; and on descending them we find the same progression in vegetables and animals, as in going from the pole towards the temperate countries.

On this side of the polar circle, the great forests of resinous trees, cover the sides of the mountains with green verdure. The plains are dotted with fruit trees, as apple, pear, almond, cherry, plum, &c. with legumes and æreal plants. To 68°, on the dried marshes and pods are mustard and mint; and on the banks of rivers, hemp and flax. But as we pass through the *temperate* zone, the resinous trees are replaced by the oak, maple, elm, lime, walnut, fruits, legumes, and herbs.

The temperate zone of America differs from that of the Old Continent; yet less so than the torrid zones. The plane and tulip tree are the largest and most common; some being 47 feet in circumference; but there likewise grow the maple, beech, acaeia, poplar, and walnut; the shrubs annona and benjamin ginseng is common in Lower Canada, Georgia, and the valleys of the Alleghanys; westwards are service-trees, thorny woods, and black poplars; and northwards alder and birch join the resinous.

The plains watered by the Mississipi are covered with forests and amazing trees, which fall and decay into mould. The plains of Kentucky have high and thick grass, with wild vines scattered; and the borders are filled up by clumps of trees to the forests of Louisiana. Here are seen also large herbivorous quadrupeds; as the orignal, and bison, and the musk. The horses, (introduced by the Spaniards), are strong, high, and vigorous; but degenerated in shape and pace. The other carnivorous animals, are the black wolf and its varieties, ounce, and cat; but all such animals are less fierce, strong, and numerous, than on those of the Old Continent. Small quadrupeds are more numerous; and rats, from Europe, advance with population.

The torrid zone presents a plain intersected with meadows, and with plantations of sugar-cane and tobacco; the hills produce indigo, coffee, and cotton plants; and their tops afford mahogany, sapsta, arocato, orange, and other aromatic trees. And the Spaniards have introduced all the domestic quadrupeds of Europe. On the shores of the Gulf of Mexico grow the dye-woods, palms, creepers, and juicy plants. The forests are separated by lakes, marshes, and heaths; meadows are scarce; the the trees produce the finest flowers, and the ground is a carpet of reeds and rushes. Here are the conguar, jaguar, and other ferocious animals, some in size comparable to the lion and tiger. Plantations of mulberries cover the interior between the seas. The high plains of Mexico present the productions of both worlds; wheat accompanies rice; oranges and aromatics mix with fruit trees; the vine and the palm are contrasted; and resinous trees vegetate on the mountains. Valued indigenous vegetables are carefully cultivated, as the vanilla, and cactus, on which cochineal is gathered.

In travelling from Perote to Vera Cruz, says Humboldt, the Mexicans descend in sixteen hours from the region of pines and oaks, from a mountainous country where the thermometer very often sinks at noon to four or five degrees, to a burning plain covered with cocoa trees, with mimosa cornigera, and other plants that vegetate only under the influence of a strong heat. These mountaineers feel a difference of temperature of eighteen degrees; and this difference produces the most fatal effects on the organs, by exciting their irritability. A very sensible decrement of heat is observed on the globe, whether we go from the equator to the poles, ascend from the surface of the earth into the highest regions of the air, or dive into the depths of the ocean; and this phenomenon has a great influence on the climatic distributions of vegetable and animal productions. Nothing equals the beauty and mildness of the climate of the equinoctial region on the ocean. While the trade wind blows strongly, the thermometer keeps at 84 or 85 degrees in the day, and at 82 or 83 degrees during the night. To feel the full charm of these happy climates bordering on the equator, the passage from Acapulco or the coasts of Chili to Europe should be undertaken in a very rough season. What a contrast between the tempestuous seas of the northern latitudes, and the regions where the calm of nature is never disturbed!

“We were never wearied (says Humboldt) in admiring the beauty of the nights; nothing can be compared to their transparency and serenity. We were struck with the innumerable quantity of falling stars, which appeared at every instant. The farther progress we made towards the south the more frequent was this phenomenon. I have observed during my excursions that these igneous meteors are in general more common and luminous in some regions of the globe than in others; I have never beheld them so multiplied as in the vicinity of the volcanoes of the province of Quito, and in the part of the Pacific Ocean which washes the volcanic coasts of Guatimala. The influence which place, climate, and seasons, appear to have on the falling stars, distinguishes this class of meteors from those which give birth to stones that fall from the sky (aerolites), and which probably exist beyond the boundaries of our atmosphere.” In the night also between the Tropics, swarms of phosphorescent insects glitter in the air. The picturesque effect of the glow-worm cannot be compared to those innumerable, scattered, and moving lights, that embellish the nights of the torrid zone.

In describing a West India landscape, Humboldt says, “Our eyes were fixed on the groups of cocoa trees that border the river, and the trunks of which, more than sixty feet high, towered over the landscape. The plain was covered with tufts of cassias, capers, and those arborescent mimosas, which, like the pine of Italy, extend their branches in the form of an umbrella. The pinnated leaves of the palms were conspicuous on the azure of a sky, the clearness of which was unsullied by any trace of vapors. The sun was ascending rapidly toward the zenith. A dazzling light was spread through the air, along the whitish hills strewed with cylindric cactuses, and over a sea ever calm, the shores of which were peopled with alcratas, egrets, and flamingoes. The splendour of the day, the vivid colouring of the vegetable world, the forms of the plants, the varied plumage of the birds, every thing announced the grand aspect of nature in the equinoctial regions.”

In the African continent, which forms the greatest mass of tropical land on the surface of the globe, the rains occur regularly in the following order: In the northern tropic some showers begin to fall in the mountainous regions in April, and become more frequent in May; but it is not till June that the great and general flood takes place. Its approach is announced by violent storms and tornadoes; and for the three following months it pours down in torrents almost without intermission. The face of nature is soon entirely changed; the rivulets, before dried up, swell and become like rivers; the rivers overflow their banks and resemble seas; and, in many instances, large tracts of country are entirely laid under water. In the course of September, the rains abate, and at length entirely cease; the sun re-appears, and calls forth an unbounded luxuriance of vegetation. From this time till the following spring not a drop of rain falls. In the southern tropic, this arrangement of seasons is entirely reversed. The rains begin in October, and continue till March; after which the dry season commences, and continues during the rest of the year.

In India, the rains are brought by the south-west monsoon, which, as already noticed, continues from April to October. The phenomena which they present are very striking, and are described by Mr. Elphinstone in the following animated terms: "The approach of the monsoon is announced by vast masses of clouds that rise from the Indian ocean, and advance towards the north-east, gathering and thickening as they approach the land. After some threatening days, the sky assumes a troubled appearance in the evening, and the monsoon in general sets in during the night. It is attended by such a thunder storm as can scarcely be imagined by those who have only witnessed that phenomena in a temperate climate. It generally begins with violent blasts of wind, which are succeeded by floods of rain. For some hours lightning is seen almost without intermission; sometimes it only illuminates the sky, and shews the clouds near the horizon; at others it discovers the distant hills, and again leaves all in darkness, when in an instant it re-appears in vivid and successive flashes, and exhibits the nearest objects in all the brightness of day. During all this time the distant thunder never ceases to roll, and is only silenced by some nearer peel, which bursts on the ear with such a sudden and tremendous crash, as can scarcely fail to strike the most insensible heart with awe. At length the thunder ceases, and nothing is heard but the continual pouring of the rain, and the rushing of the rising streams."

The storms of Europe, sublime as they are, are not comparable with those of the tropical regions. The mountains of Kendokoo, near the Ganbia, are cultivated to their summits; villages exist in their romantic glens, and the inhabitants listen, with solemn, yet not delightless awe, from the tremendous precipices, as the thunder rolls, in lengthening volumes, along the narrow defiles. Thunder is heard among the Andes; but lightning is not known in Chili, and scarcely at the Cape of Good Hope, where thunder is more so. During a thunder storm, the Persians go to prayer; but the Indians of New Holland rush out of their huts and deprecate its vengeance.

A flash of lightning once discovered an invaluable treasure. Near Paz, in Peru, is the mountain Telemain, on which, a flash of lightning striking, severed a crag from its girdle, which, falling on the side of a hill, discovered in the fragments such an immense quantity of gold, that its price was very low for some time. Only what was obtained from the crag, however, has been advantageous; for the part whence it broke off is entirely and constantly covered with snow and ice.

Than a monsoon, few things (says Bucke) are more sublime in the whole range of Nature's phenomena. It is preceded in June by violent blasts of wind; lightning then appears in the distant horizon; soon it approaches nearer, appearing and disappearing every instant; thunder then rolls in immense volumes, and at length bursts in numerous sudden and tremendous crashes. When the thunder ceases, rain descends for many days; the sky then clears, and the face of nature, before as if fainting with drought, now assumes a renovated aspect; the rivers are full and tranquil, the air pure and delicious; and the sky varied and embellished with clouds. Gentle rains then ensue; become more violent in July; abate in Sepember; and depart as they came amid lightning, thun-er, and horrible tempests.

One of the most dreadful monsoons is given by Forbes, ho was nigh perishing in its devastating effects. The ritish combined force lay encamped at Baroche; and vere preparing to renew their march after the enemy, the ext morning. In the night, however, the heat became ppressive; the sky darkened; stillness pervaded the air; and, in a few minutes, the clouds burst, and a deluge poured upon the plain, in a manner almost inconceivable. The tents ere long gave way; the water rose, and 200,000 horses, oxen, camels, and elephants, with 100,000 human beings, were exposed to the visitation, in a strange country, and enveloped in darkness, rendered more awful and sublime by vivid flashes of lightning; In the morning it was discovered that 200 persons had perished. The plain was covered with carcases of beasts, some half covered with mud, and others in a state of positive putrefaction. Women were seen perishing with wet and fatigue; old men contending for life; and parents bearing the dead bodies of their children.

Wind is air in motion; air, being elastic, will, if expanded by heat, or compressed by cold, rise and put all around in motion. Like water, it is always in action, till it has acquired an equilibrium; hence a breeze, a gale, a storm. Certain coasts are subject to particular winds. The general trade winds extend from 30° N. to 30° S. latitude; they travel, like the sun, from east to west, all the year; a peculiarity, supposed to be caused by the Solar power of expanding the air beneath. Monsoons are winds, which fly six months in one direction, and six months in the opposite; changing at the vernal and autumnal equinoxes; and are in the east, what hurricanes are in the west. In certain parts, also, are sea and land breezes, extending about three leagues from shore; blowing from land to sea from midnight until noon; and from sea to land, from noon till midnight.

In America, the immense chain of mountains which runs parallel to its western coast, modifies greatly the operation of the rains. The sides of these mountains, and the table lands at their foot, are deluged by frequent and copious showers; but the plains interposed between them and the Pacific ocean, though overhung with almost perpetual clouds, are entirely destitute of rain. Fertility is preserved only by the numerous torrents poured down from the Andes; and where these fail, the soil becomes sandy and barren; for the dews, though copious, are not sufficient to produce the requisite degree of moisture. In the vast regions between the Andes and the Atlantic, the rains are regulated by nearly the same laws as on the opposite continent of Africa.

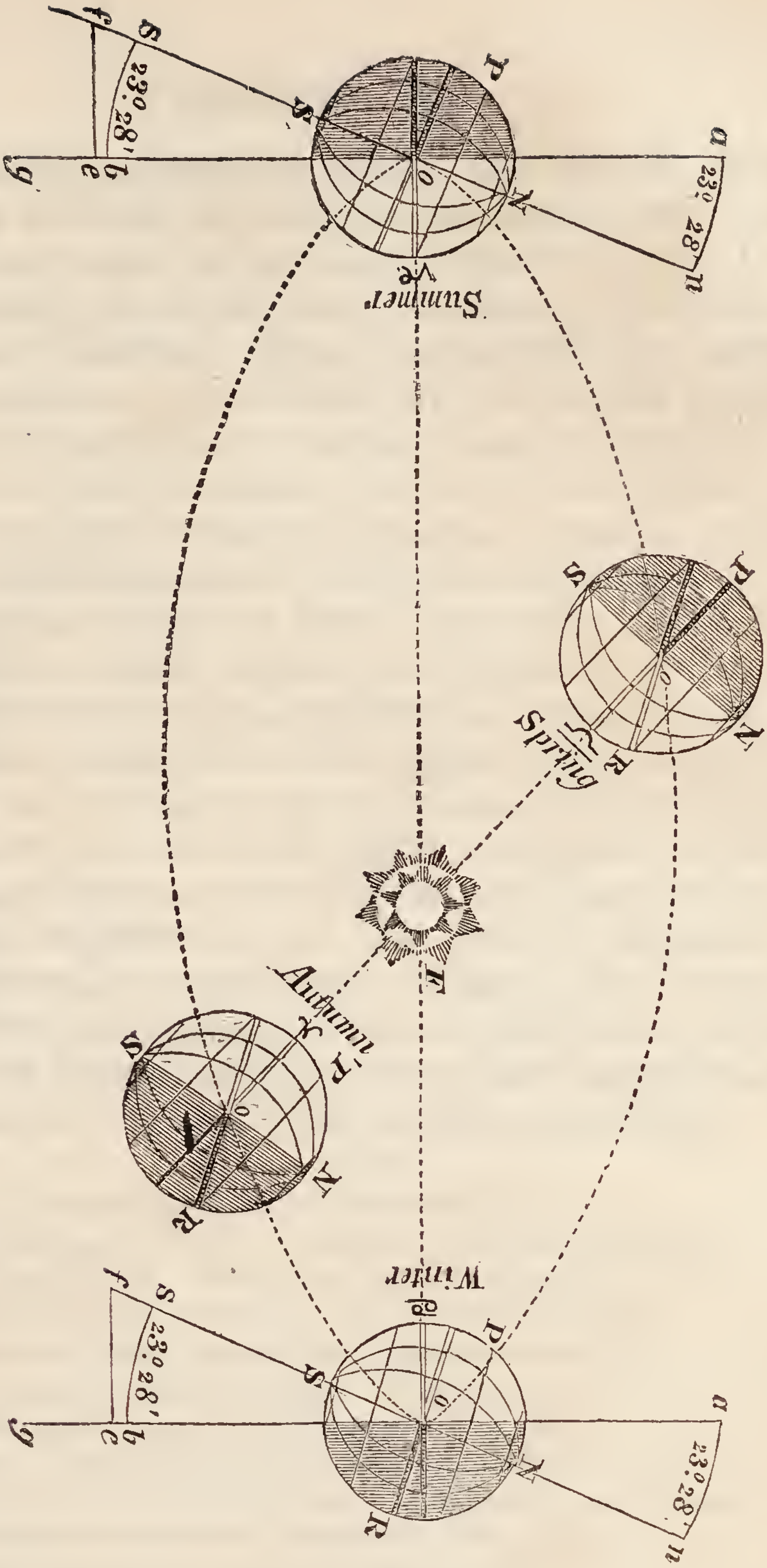
In all the temperate climates, rain, like the other atmospheric phenomena, is governed by complicated causes, and cannot be calculated by any fixed rule. In Britain, moisture is chiefly poured in from the opposite points of the south-west and north-east; the one borne from the vast Atlantic, the other drawn from the depths of the Northern ocean. As the former affords by much the most copious supply, the western parts of the island are consequently more subject to rain than the eastern. The wind, which blows due east, having passed no sea except that comparatively narrow one called the German sea, brings merely fogs upon the eastern coast of Britain, which do not reach the western.

In some countries, summer reigns incessantly; and every day of the countries about the middle of the globe, called the TORRID ZONE, equals in warmth the hottest of our summer. The duration of light and darkness is almost equal throughout the year; and the days being thus shorter than ours, the intense solar heat is more supportable, than it could possibly be, was the sun as long above the horizon as in our summer. The seasons are not reckoned, as by ourselves, by summer and winter; but by dry, moist, or rainy weather; for when it would be called summer, the sun having his greatest altitude, and his rays falling vertically, the rains commence, and continue some weeks. Hence in these countries, the most pleasant season is when the sun has least altitude.

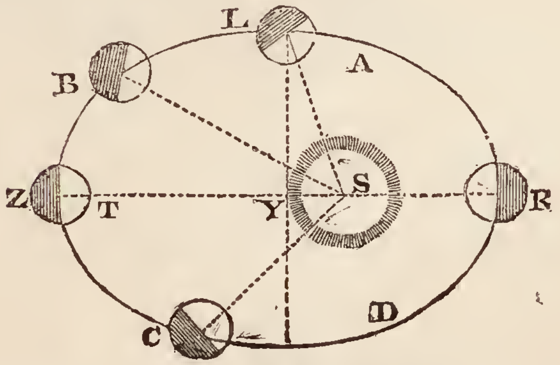
In some countries, on the contrary, an almost constant cold prevails; and every day equals our early frosts; while some times the warmest is more intensely cold than our coldest winters. These are in the FRIGID ZONES.

Only during a few weeks, out of the whole year, is there sufficient heat for the few trees and herbs found in those regions, to grow and become green; but neither the trees nor the earth produces fruits which will nourish man; and there is the greatest length of day and night; each being of several months duration. In these parts exist Ice-islands and Icebergs, which are of two kinds, of sea-water, and fresh-water; the former white, and scarcely transparent; the latter blue, and so transparent, that objects may be seen to a considerable distance, and are mostly formed on the sides of rocks, jutting over seas or rivers. These may carry with them, foxes, ermines, bears, seals, walruses, wild fowl, the spawn of fishes, and the eggs of northern birds. In summer the lower extremities melt by the solar influence, and the moisture of the waves below. Thus undermined, their bulk is too ponderous for their base; they break, fall into the water, and float; then unite with others, and form islands of vast length, breadth, and height; and often sail with the winds, currents, and tides, from the arctic circle to the utmost extremity of the temperate zone; exhibiting, in their progress, innumerable combinations, of towns, cities, and villages; trees and flowers; ruins and palaces; and myriads of forms before unknown even to the imagination. Icebergs are frequently of a light verdigris blue, varied with tints of red; some are a sea-green near their bases, with snow white summits. Some are two miles in circumference; often aground even at the depth of three hundred fathoms; some are 367 feet high; and if reduced to a plane of one inch in thickness, they would cover an area, equal to 21,000 miles; and, Parry says, if weighed by measurement, would equal 1,292,397,673 tons.

In these regions too are seen the Aurora Borealis, sometimes covering, with inconceivable magnificence, the concave of the whole hemisphere; changing their positions every moment; now resembling vast pyramids; or stretching into innumerable columns; varying their shapes and colours with astonishing rapidity and endless caprice; now vanishing in a moment, leaving the heavens sombre and black; or returning with increased splen-



The Seasons Exemplified.



Orbit of the Earth.

dour, shedding a matchless glory over all the heavens. Seen from Iceland, the northern lights proceed from the east and south-east, as well as the north; from Greenland, generally from the east; Lapland, often from the south; and Hudson's Bay, it resembles an umbrella, darting streams of light from every part of its periphery.

The two TEMPERATE ZONES, situate between the torrid and the frigid, occupy most of our globe. The countries in them have four seasons, varied as they are near the adjoining zones. In Spring, the trees and plants put forth their buds, the heat is moderate, and the days and nights are nearly equal; in Summer, the fruits of the fields and trees ripen, the heat is powerful, and the day sensibly longer than the nights; in Autumn, the fruits and seeds fall, the grass becomes dry, the heat diminishes, and the days and nights are equal; in Winter, vegetation of plants is partially or wholly suspended; the nights are lengthened, and the cold is increased; the earth is frozen, in our climate seldom a foot deep, and mostly about six inches. Wine is peculiar to these regions; and Nature seems to have placed herein the greatest diversity of vegetable and animal productions.

Look Nature through, 'tis revolution all;
All change, no death. Day follows night, and night
The dying day. Stars rise, and set, and rise.
Earth takes th' example: see, the summer gay
With her green chaplet and ambrosial flowers,
Droops into pallid Autumn. Winter gray,
Horrid with frost, and turbulent with storm,
Blows Autumn and his golden fruits away,
Then melts into the Spring. Soft Spring, with breath
Favonian, from warm chambers of the south,
Recals the first. All, to reflourish, fades;
As in a wheel, all sinks, to reascend:
Emblem of man, who passes, not expires.

LECTURE LXXXV.

GENERAL VIEWS OF VEGETABLES, INSECTS, AND REPTILES.

Look round our world; behold the chain of love
Combining all below and all above. POPE.

How preserved—the chain unbroken upward—
From the mute shell-fish gaping on the shore,
To men. AKENSIDE.

WE shall now give a brief yet correct sketch of the chain of Organic Bodies upon the earth, that all the links of the preceding Lectures on the productions of Nature may be rendered more obvious, and that the mind may be fully satisfied that the whole, in its arrangement and completion, illustrates the attributes of its great Creator.

Nothing is isolated in the Creation—all is connected and dependant. Nothing is abrupt—all is graduated and succesive. In descending from the great to the small—the Universe includes the clusters of Suns—the suns embrace systems of Planets—and the planets regulate Satellites; while elastic Gas connects the whole by transferring the force of each to the others, with an intensity diminishing as the square of the distances. Our planet, and probably the whole of them, is covered with the results of eternal and universal activity. Rocks, Vegetables, Fishes, Birds, and Animals, each an apparent consequence of the other, ascending by a series of connecting and imperceptible links. To examine and trace these links is our present interesting object.

The reader, who has perused the previous volumes, will feel delight in having the detached and isolated subjects brought into a connected picture; and others, who seek knowledge without the labour of much reading, will in these Lectures derive many valuable ideas from such general sketches of Natural History.

Vegetation, like animal life, of which it is only the first degree, consists of a series of phenomena which have their periods of increase, stability, and decrease. In infancy producing the mosses and ferns; in adolescence, the cactusses and other incomplete plants, mounting progressively to trees.

Euphorbia

Coccus Plant and Insect.

The MOSSES, so numerous in species, varied in forms, and admirable in fecundity, are the first result of vital action; unless we first regard the *lichens*, dispersed over granite in powdery crusts, or extended on the soil in foliated membranes; or those *hepatics*, drawn on stones, like cuttings in rose-work, fringed on the borders, surmounted centrally by little capillary threads, probably supporting the generative organs. But these, whose structure is known imperfectly, seem lost and confounded in the great family of the mosses. Natural to all climates, and living under all latitudes and exposures, the mosses begin the staminiferous plants. They are surmounted by five verticle threads, on which rest little urns, whose corol rises in the flowering season to expel the fecundating pollen. In ferns, the organs of reproduction are more apparent, situated on the inferior side of the leaves, some of which have an herbaceous, others an arborescent stalk. They present numerous varieties much diffused.

The ambiguous characters which mark the first links of the chain, are found again in fat plants, which, in deserts and sands, have the same functions as mosses and ferns in humid and miry spots; both fertilise the earth by their fragments. The *purslain*, with fleshy succulent leaves, the hairy *ficoids*, the *sedums* with a cylindrical stalk, the imbricated *saxifrages*, and the thorny cacluces compose this family, whose strange forms vary from the ordinary aspect, and are feeble sketches of vegetables, though their characters of fructification being very apparent, might warrant their being placed higher in the chain.

The family of the *tithymali* follow the fat plants, by the *euphorbia*, which want leaves, have soft and fleshy stalks, and tufts of thorny hairs, and approach nearer the tithymali, by the organs of fructification, and the nature of the juices, which in all these plants is lactescent and caustic; venomous in the *marioc* and *manchinil;* gluey in the *gluta;* gummo-resinous in the *euphorbia;* and resinous elastic in the *caout-chouc*, &c.

This milky juice is also found in the *fig-tree*, which, like the preceding families, has thick hairy leaves, hard to the touch; the wood is spongy; the fruit, the receptacle of the organs, rests on the stalks, like that of the cactus, which it resembles in form and qualities.

Some exotics are classed with the fig, as the ambora, dorstena, perebea, and the bread-tree, whose receptacle is covered by a thick pulp, the principal food of the natives of Otaheite.

Rejecting the ligneous fibre of the fig, most of its characters are in the *cucurbitaceæ*. The stalks are filled with a bitter and caustic juice in the *cucumber* and *elaterium*. The leaves are broad, thick, and hairy, but the sexual organs are not contained in one receptacle; and male or female flowers rise on peduncles separated along the stalks.

The Indian *plum*, *elm*, and *fothergilla* have the leaf of the mulberry, reduced, and with weaker fibrils. *Willows* and *poplars* have white, lax, and porous wood. The ligneous tissue gradually closes, and the fibre is coloured in the *liquidambar*, *birch*, *alder*, and *nut;* which is much increased in the oak, by the tanin, or astringent principle. The *cork-tree*, *horn-beam*, *beech*, *chesnut*, and *plane*, differ but little from the oak.

The *tanniferous* trees lead to the *resinous*. The former lose their leaves during frosts, while the latter preserve their foliage and verdure. Yet these opposite characters have shades; the oak does not shed his faded leaves till they are replaced by new shoots; in the resinous trees, though tanin is not incorporated with the wood, it is found in the bark. The wood is fat and knotty, the flowers have husks like the *amentaceæ*, but the fruit resembles a cone. The name *conefera* denotes this family, including the *filao*, *yew*, *arborvitæ*, *cypress*, *larch*, *fir*, *cedar*, *pine*, and the *juniper*, whose juice, by its strong odour, approaches the turpentine trees. The turpentine trees, approaching the coniferous by evergreen foliage, resinous juice, fat wood, and presence of tanin, differ in the organs of fructification. But in these the flower shows itself complete. The sexes in the same corolla communicate directly. Such is the hermaphrodite fructification which long predominates with slight modifications, but which at length changes the sexual relations.

The turpentine trees contain some diœcious species, as the *pistachio* and *lentiscus*, whence are extracted turpentine and mastic. Those with hermaphrodite flowers include the balm-trees, as the *amyris*, which yield those of Mecca, and those of Judea, the *tolu*;

the *Gomart*, whence rosin is produced, and the *sumac*, which yields varnish, and contains much tanin. Others bear fruit, as the mango, or are unctuous, as the anacardium and the acacia, to which latter the walnut has much affinity, but its flowers are monœcious.

The *buck-thorn* follows the turpentine, and contains mostly green shrubs; as the *spindle-tree*, *false pistachio*, *polycardium*, *holly*, &c., all resinous, and from which even a sort of glue is extracted. The dyospiros of Virginia has leaves like the lemon; ebony furnishes esteemed wood, the alibusium furnishes styrax, a balsamic gum; and the rose of Japan connects the diospiros with the rhododendron.

The heaths of the European species exhibit several exotic varieties, distinguished by their elegant forms and singular flowering. The *arbutus*, whose fruit is a berry, roughened with little tubercles, resembles a strawberry, but is insipid in taste.

The *whortleberry*, whose fruit is acid, by its aspect and balsamic odour, makes a natural transition to the myrtle, to which family belong the *syringas*, *guava*, *jambos*, *pomegranate*, and *clove-tree*. The volatile oil, which gives the aromatic taste of the clove-tree, more abounds in the laurel. The aroma of laurels fully approaches that of the *cinnamon-tree* and *camphor* (varieties of the laurel), whose perfume probably results from the climate. The *nutmeg-tree* has also its first fruit contained in folds, and has a strong aromatic taste.—These qualities again appear in the *mimosa*: the *carella* even affords a bark, which is called *white cinnamon*. The *Sandoricum* of the Philippines, the *mimosa nilotica*, and other species of this family, have all their parts impregnated with a volatile oil, of a strong and fetid smell. Its presence is more agreeable in the *orange-tree*, *the citron*, *lemon*, *bergamot*, &c. The *tea-tree* is in this family, though it approaches only by its flowers and aromatic smell, but it wants the stateliness of the orange.

The *garcinia* has great affinity with the orange-tree: the *mangoustan*, whence gamboge is drawn by incision, bears a fruit much like the orange in form and taste; all these trees are exotic, and yield resinous juices; as also *hypericum*: these juices, gradually losing their aromatic qualities, become very saccharine in the *maple* family, including the Spanish chesnut.

Hitherto the trees which have juices are impregnated in their whole substance. In the soap-tree only, the fruit contains a fixed oil, combined, perhaps, with an alcali, thus forming a natural soap in the bark. The fruit of the olive also contains much fixed oil, mixed with mucilage: this conformity in the fruit of the soap-tree and olive, unites their families, and they are very similar also in their flowers.

The *cynarocephali* comprise a few exotic species: the *carthamus*, employed in dyeing; the artichoke, the cardoon, the thorny cardoon, the jacea of the gardens, the blue-bottle, the centuary, smelling like amber, the serratala, with indented leaves, and several others, are cultivated in Europe. This observation agrees with the endive kind, among which the salsify, scorsonera, endive and lettuce are useful. Their milky juice, their distinctive characteristic, is found again in some campanulacea and dypsacea. The rubiaceous connects itself with the dypsaceous, both by the naked seeds, and the quality of the nature of the juices; the gallium, cross-wort, and madder, are useful in manufactures. Bark is a most powerful febrifuge, and the coffee-tree furnishes an agreeable drink. The honey-suckles contain several parasite species: in this family are also the laurustinus, elder, and cornel-tree.

The aralias comprise only the aralia and ginseng, both medicinal. Parsnips and carrots afford a substantial aliment; the imperatoria, cummin, angelica, are esteemed for their aperient and sodorific virtues; the ferulas, yield gummo-resinous juices, very disagreeable in the asafœtida; and the hemlock is noted for its poisonous qualities.

The *ranunculuses* also contain poisonous plants, as the *actæa*, the *podophyllon*, and the *aconite*. The seeds of the *delphinium* are dangerous, and all the species are purgatives. In the papaveraceous tribe, which follows, are the wild poppy, poppy, chelidonia, and fumitory.—In the cruciferous, the species have an acrid stimulating quality, as in the horse-radish, radish, mustard, and turnip. The caper-tree has little affinity with the cruciferous. The family apparently nearest the caper is the barberry.

The menispermes and arbustus-sarmentous shrubs form the transition from the barberry to the vine.

The uvaria, whose fruit resembles that of the vine, leads to the anonæ, an exotic shrub, whose fruit is an amalgam of several berries, with a rough bark, containing an alimentary pulp.

The cruciferous do not contain many species; but in the malvaceous are included all emollient and mucilaginous plants. The bombax, to which belongs the adansonia, or baobab, is the largest tree known; and having a close affinity with the tulip tree. The down surrounding the seeds connects it with the cotton-tree; with the latter is the cocos, famous for its fat almonds; next the althaca, marshmallow, and mallow.

After the mallow is the geranium; next the nasturtium, with flexible stalks; the balsam, with multiflower peduncles, and the dwarf-elder. The other rutaceous plants are distinguished by their balsamic odour, which predominates in the rue, but is milder in the dyctamus and fraxinella.

The leguminous begins with balsamic plants, as the *myros permum*, several exotic trees, and the copaiba, which affords the balsam. This *aroma* is perceptible again in the saintfoin; grows weaker in lucern, clover, and other meadow herbs; is replaced by fecula in the harico, lupin, and, combined with saccharine matter, exists in some lotuses.

The leguminous is always distinguished by the form of the fruit, and monopetalous flowers. Numerous species have daily motions in the leaves, very peculiar in the sensitive plant. Besides relations drawn from the external configuration, the acacias connect the leguminous family to the rosaceous, which afford a gum almost as pure as the gum-arabic from the Senegal acacia.

Of this class are the cherry, almond, peach, apricot, and plum. The apple, pear, quince, medlar, service, and lote-trees, resemble the foregoing. The eglantine, a thorny bush, confined to rocks, may be traced in those rose-trees whose flowers excel all others in their delicious perfume and lustre. In the raspberry is still seen the bramble; to which approximate the fibrous strawberry, creeping *potentilla*, &c. The agrimony, pimprenels sanguisorba, have analogy with the eglantine; and the *dryas* and the *bennet* are between the rosaceous and caryophyllaceous. The flax and pink are the most remarkable caryophylli. The pink leads to the violet, of which the ipecacuanha is an exotic variety. The plants which belong to the cistusses, as also the helianthemum, are different from the turnsole, because, instead of turning similarly, it only manifests a spontaneous movement in its stamens. The cistus yields, in the Grecian isles, that gluey and soporific resin called laudanum.

The tileaceous class, the flowers of the lime-tree, bear an analogy to the cystuses. In the sapotas, as in the lime, the flowers are small, pedunculated, in little bundles: the seeds of the sapotas are aperient. In the apocyneas this pernicious quality is more marked, as in the olcander: the apocyna has a flower containing a honied liquor, of which flies are fond, but which becomes fatal by the approximation of certain tubercles, which close by the irritation of the flower.

The Gentian is not easily distinguishable from the foregoing. The bignonias, from their winged seeds, succeed the apocynas. The catalpa is the finest tree. The solanums are more interesting: the species which have a berry for fruit succeed the sebestenas, as the calabash, whose fruit resembles the gourd; the pimento, with red and peppery berries; the morellas, melongenas, the belladonna, a violent narcotic, and the mandragora, an active poison. Those which have a capsule for fruit belong to the family of the scrophularias; as the stramonium, or datura, a poison like the mandragora; tobacco, whose use is become so general; the stupifying hyoscyamus, and the verbascum, with a downy stalk.

The flowers of the acanthus resemble those of the scrophalaria. The flower in the family of the pedicularis, contracts an irregular form.

We find double arrangement in all the tuberous and bulbous families. The monocotyledons include the vallisniera, an aquatic herb, whose flowers, borne on two individuals, approach and unite by movements, supposed to be voluntary; the nelumbo, or Caribbee cabbage, whose root resembles a chesnut; the water-lily, which floats on the water, with green pulpous leaves, and its flowers as white as snow; and the morrena, another aquatic plant.

In the family of the orchis, the anther is imperceptible, but a mass of pollen may be discerned, of which the diversely agglutinated grains give the flower whimsical and uncommon forms. Fecula abounds in these tuberous roots, which is acrid and aromatic, as in the costus, of the Indian reed family. Ginger, or cardamon, also contains the aroma in its roots and grains.

With the family of the iris commences the transition from tuberous to bulbous roots. In the saffron the root is composed of two tubercles, the oldest exhausting itself to support the new one. Among the numerous species of this class, is the florentine iris. In the family of the narcissus are the tuberose and jonquil, the lily of the valley, and narcissus, the beauty of our gardens; the crocus, announcing the return of spring; the amaryllis, a most beautiful flower, surpassed only by the odour of the rose; the hemerocalla, which contrasts with the amaryllis and formosa, distinguished by its milk-white flowers. In the asphodel class are the leek, ornithogalla, squill, phormion, or flax of New Zealand, hyacinth, and asphodel. The tulip, the crown imperial, and the lily all belong to a family closely allied to the asphodel.

In the plants with fibrous roots are the aloes, whose flowers alternately approach the lily and the asphodel, yet still preserve a peculiar character. The agave is thorny like the aloes, and analogous by its mode of growth, and phenomena of flowering; the anana, which resembles the agave in foliage, but differs in its stalk, is succeeded by the crowned pine-apple, the most exquisite of fruits; next is the quince, which approximates to the palms. Between the yuca and palm, however, is the dragon-tree, which furnishes the dragon's-blood, having the foliage of the first, and the stalk of the second. These mixt characters exist also in the dianella, the rotang, licualla, corypha, and several other trees, till we arrive at the palm, of several species, the hermaphrodite chamærops, and the areca, whose fruit furnishes betel; the elata is merely a variety of this class; the cocoa-tree trunk rises sixty feet, surmounted by ten or twelve large leaves; the sago tree, conceals in its trunk a pure fecula, which forms food for the inhabitants of the torrid zone. All these palms are monœcious; but some have individuals of both sexes, as the date, with a saccharine fruit; the elœis, with an oily fruit.

The reed connects the palm with the gramineous classes, which have the foliage of the former, and the knotty stalk of the latter. The bamboo is as valuable to the inhabitants of China, as the cocoa-tree to the Indian. The sugar-cane unites the qualities of the sago and date. Maize, resembling the sugar-cane in its stalk, leads to the numerous family of the gramens. In rice, barley, and millet, the fecula is almost pure, as in sago and maize; in the oat, it is mixed with a small portion of sugar; in rye, with mucilage; in wheat, with gluten. Then follow gramens, which are more appropriated to the nature of the herbivorous, as the quaking-grass, felucca, melica, vulpina, &c.

The alismoids comprise the flowering rush, water-plantain, sagittaria, and connect the last monocotyledon families, the cyperus, or papyrus, typha, and aroides. The typha and the water-ribbon are also marsh plants, whose leaves have some relations with certain algæ.

Among these plants, some float in stagnant waters, as water-grass, which approaches the rush. Besides the true rush, which comprises numerous species, are myagrum with green or blue flowers; ephemera, which flourishes in an umbel; white hellebore, an active poison, and colchicum, with tuberculous roots. The rush has some affinity with true asparagus, and this with sarsaparilla and yam, whose tuberous root is as wholesome as the potatoe.

The transition from wood, almost wholly matter, to flesh, essentially vital, is effected by an intermediary substance, i. e. the fungous substance progressively brought on, first, by altering the ligneous tissue in the palm, and afterwards by its disappearing in aquatic plants, leaving only a mixture of fecula and mucilage. In the algæ this character disappears. The fuci have seminal vesicles, scattered as real germs along their stalks. The ulvæ, confervæ, and byssus, present the same characters. The lichens, with a ramified and feculent stalk, resemble the last class. The last form a natural transition to the family of the mushrooms; for the truffle also contains fecula, and its substance has not the real mushroom's *fungosity*, traversed by ligneous fibres in the *agaric*, and some *boleti*, shows itself alone in the *moril*, *hysoperdon*, *nidullaria*, *clathrus*, *capilline*, and mouldiness.

The variety, aspect, and forms, all whimsical, are (of the mushrooms) the distinctive characteristic, and this astonishing variety of forms, which proves its great suppleness, is still very remote from what it must attain to resemble flesh. But why is the mushroom so near the animal? Chemistry has, by analysis, effected this approximation, and consummated this affinity. The tremellas, so near the mushrooms; the nostoc, after the tremella; the monad, that microscopic point of whose movements we are ignorant, which feeds on what it absorbs, and reproduces by subdivisions, can be scarcely distinguished from each other. In these, the fungosity assumes the character of gelatine; but instead of disappearing, serves as a cellular tissue. Neither does the locomotive faculty arrive all at once; it shews itself in the parts of all the plants; it is exerted entirely in several algæ, and successively in the tremella, nostoc, and monad.

Sprung from the fermentation of fecula, like mushrooms from the fermentation of mould, these last subjects, as well as the volvox, proteus, vibrion, bursarius, and kolpode, take part in life wherever a drop of water manifests in the fecula and gluten, that intestine movement, that spontaneous agitation of the molecules, by us called *fermentation*. But it must not be imagined that this phenomenon is produced immediately; only by the heat caused, does it facilitate the development of a germ previously existing.

By retrenching from a plant its roots and branches, from a flower its stamens and pistils, nature forms a gelatinous pulp, apparently more simply organised; but in fact executing more extended functions, feeding by digestion. Still the object is only half attained; the parts of plants are only divisions or prolongations of the stalk; the animal requires parts, which, articulating and jointing into each other, may serve for more varied uses, and voluntary movements; but this change is only by degrees, and not intrusive.

The first indications of it are in the *cercaria*, *trichocerca*, *trichode;* infusoria are provided with appendices in the form of hairs. The rotiferous polypus has an alimentary bag, its orifice furnished with ciliated and rotatory organs, to favour the entrance of aliments not yet rejectible by the animal. The gelatinous pulp constantly becoming softer, wants a support, like a centre of all its motions. This centre is a membranous body, horny and immovable, also an envelope in the phematellas, tubularias, sertollarias, &c. This body, transformed into an incrusted axis, supports myriads of polypi, which hold by it, and all communicate therewith, as in corallines, sponge, and gorgonia; becomes strong in coral by addition of calcareous matter, and partakes of life by an epidermis, covering it in the same manner as the periosteum the bone. This epidermis receives the calcareous matter on its sides, by innumerable little cells, that solidifies, and allows them to affect those varied forms remarked in madrepores.

This ingenious mechanism, whose springs have all been worn, allowed only partial movements, because always including a prop foreign to life. On the supple and lengthened horny axis has been fitted a flesh common to myriads of animalculæ, which, pushing out their radial tentacula, united to move this sort of floating machine; the veretillas, pinnatulas, umbellarius, &c. At length this life, common to several individuals, (still rather analogous to the branchy tree, reproducing itself by slips; and the ramified *polypier*, regenerating itself by segment,) disappears to make place for subjects enjoying life of themselves, yet resembling the polypi in organization; as the pedicellarias, hydras, and actinias, called *naked polypi*.

By how varied means and modifications does nature accomplish her designs! in the plant, she divides an almost inorganic tissue, and thence multiplied, *ad infinitum*, she forms accessory parts to supply the inertia of the trunk; in the animal, she begins by separately organising divers parts, provided with peculiar faculties, which she afterwards unites and assembles to form a whole, enjoying a life eminently active; and, not to insulate these two great results, she agglutinates microscopic points, which, deprived of organs, but not of sensibility, communicate the impulses of sensations from one to the other, from external objects, and live in common; this organic whole, though losing the most of its parts, does not cease to exist.

These intermediary families are called mixt by comparison; for, all being progressive, in the system of life, there are no really mixt subjects, though all appear so, whenever compared with those above or below them. Consequently, every strict method of classification will be always erroneous, from supposing exact divisions which do not exist. In the polypi, the generic character consists in the presence of a polypier, yet some polypi are without one. This privation does not simplify, but complexes the organisation; as the vital action is concentrated in one individual. The exterior conformation changes, to permit extended movements, and, by the radiated forms, nature prepares these new relations connecting the polypi with the actinias, and radials; of the latter, some very analogous to the naked polypi, are gelatinous and soft; as the physalias, porpites, medusas, pyrosomas, rhyzostomas, &c. others, as the ophiuras and asterias, have a crustaceous skin. The sea-hedgehogs are provided with prickles. The fistulides, polothurias, and siperficuli, have a naked and irritable skin, and lengthened forms. Radials have digestive organs, similar to the polypi, reduced to an alimentary bag, with a single opening, with a sort of teeth for trituration; the trachiferous pores of the polypi are more apparent; and ovaries are evinced, announcing another mode of generation.

In Worms, the reproduction by germ disappears, and makes place for oviparous generation, continuing very imperfect, being without copulation, and the eggs detaching themselves from the ovary ready fecundated. The forms vary much in this family. The gordii, proboscids, ascarides, cuculli, tentacularii, &c. are cylindrical, the bicorn and hydatids, vesicular; the tenia, lingula, and fasciola flattened. In all, the alimentary bag is complete, and has two openings; the mouth is provided with suckers; no distinct head or nervous system is apparent, and the mode of respiration is analogous to that of the preceding families.

Some persons think that all voluntary motion implies muscles and nerves; muscles are visible in worms, and in some radials; and nerves have been thought perceptible even in the actinia; were this observation just, yet a void would always be found between Worms and Insects; because, in the latter, there appears all at once an organic complication, in vain sought in the former, manifested externally, by the symetrical disposition of the parts, a character of perfection to which nature seems to arrive abruptly, by the articulations heretofore barely sketched, but here complicated in the construction of feet, wings, antennæ, &c. and, by the separation of the body into organic regions, each having distinct functions, as the head, corslet, and abdomen; the whole contained in an external skeleton of a horny and solid skin. The interior contains a nervous system, composed of a knotty longitudinal marrow, ramifying latterly into very complicated muscular tissue; vessels with stagnant liquids, but which vivify by the numerous trachea or pores, which open outwardly to draw in air for respiration; and separate sexes, yet only one copulation during the whole of life.

Numerous characters coming on spontaneously, seem to oppose the system of progression. But nature fills up this gap, by the mechanism of metamorphoses. The insect, prior to attaining a perfect state, passes through successive modes of existence, having other forms, wants, and manners. First, it is merely a worm, little different from those just mentioned; instead of flying it creeps, is without articulations, has a lengthened form, a body not easily contractile, and sensations almost null; and, as if it would not purchase its last mode of existence too dear, it apparently dies to be born again to its perfect life, which, however, it only enjoys for a few moments requisite to reproduce the species.

In regard to sustenance and growth, there is a close analogy between animals and vegetables; and the chief differences lie in the power of loco-motion, in the senses necessary to render loco-motion useful and safe, and in the fixing of atoms of oxygen so as to create animal heat and vital energy.

An animal consists of a system for nutrition, secretion, accretion, and growth; of a system of vital actions in the lungs, heart, blood-vessels, and skin; and of a system of sensation, volition, and loco-motion, in the brain, nerves, muscles, bones, and tendons. It differs from a located vegetable, in the power of moving from place to place. A vegetable would die were it removed; its subsistence depending on the secretions performed by its roots; while animals move about with vigour. Yet vegetables and animals are each sustained by a mechanism of roots, and the only difference consists in the disposition of the soil from which the roots extract nutriment. Animals carry the soil about in the cavity of their stomachs, and their roots act on the soil placed within that cavity, just as vegetable roots act in the soil in which their roots are fixed. The different powers, therefore, of vegetables and animals arise from the circumstance that in the former the pabulum of the roots is fixed, and in the latter it is carried about by the animal. The roots of animals, therefore, are the absorbents and lacteals which branch from the stomach; while the stomach itself is filled, by eating, with appropriate soil, from which soil the animal roots extract the pabulum, or nutriment, rejecting and ejecting the superfluities. Hence it appears, that, in the important and essential circumstances of sustenance, accretion, and growth, every animal is in fact a moving vegetable.

This analogy is correct, so far as regards their physical organization, their growth, sustenance, and many other particulars; but the universal fitness, or necessary result of phenomena, their purposes and ends to relative powers (without which nothing could exist as it does exist,) does not permit that fixed and loco-motive beings should have all other properties alike. As soon as powers of loco-motion are conferred on a vegetable, a new mechanism of muscles for motion, of senses to discriminate, of nerves to connect discrimination with motion, of accumulated power to effect motion, of bones for strength, &c. become necessary. A fixed organization calls for none of the perceptions or senses rendered necessary by change of locality, but is probably similar in its existence to that of an animal asleep. Vegetables, therefore, are to be considered as mere organized existences, differing in certain active powers from stones and minerals; while animals are another species of organization, having a new set of powers accommodated to their spheres of existence, without which they could not subsist in a state of well-being; and, therefore, as animals, or loco-motive beings, must long since have ceased to exist. The properties common to vegetables and animals are circulations and growth; and, in regard to growth, they equally pass through the stages of germination, youth, maturity, and decay; while the final cause of the economy of each, seems to be the propagation of the next following generation.

The first families of insects, have, like worms, a proboscis or sucker, more complicated. It is in a sheath in the flea, without wings, but having elastic feet, to execute prodigious leaps. In the hippoboscus is a non-articulated proboscis, and the two wings have balances. The proboscis is retractile in flies; whose legs terminate by spongy cushions, allowing the animal to move freely on polished surfaces. The asylus and gad-fly have similar organization; the sucker is of four threads; and in addition to the two network eyes, are three small smooth ones on the summit of the head.— These do not exist in gnats, the sucker is articulated and swelled out, the legs are provided with cushions, and the wings with balances.

These accessories disappear in the grub and cochineal; the wings, instead of balances, have cases called elytra. The bug has a sucker of three threads, like grubs; the form of the body being nearly similar. The house-bug has the mere rudiments of wings, very large in the water-bug. The grasshopper has three threads, the proboscis bent under the breast, the wings shorter than the elytra; the male has laminæ which, when shaken, produce a noise, troublesome to us; but necessary to mark the approach of the sexes. The female abdomen terminates by a saw-like augur to pierce the tree for depositing the eggs. The fulgor, much like the grasshopper, is noted for its abdominal phosphoric light. The pterophorus has the sucker, rolled in a spiral, and composed of only two pieces, without a sheath. Here we first find four wings, membranous and farinous, disposed in rays, and cetaceous antennæ serving for the touch.

The tinea and pryrabes, in their almost microscopic form, distinguished by their rich colours, have four wings rolled round the body. They are separated in the noctuella and phalæna, with a slender body, dark colour, and plumy antennæ. To these characters, the bombyx, which is much thicker in body than the phalæna, adds antennulæ, (these are to the antennæ, what the balances are to wings.) The butterfly, whose innumerable species assume such elegant forms and rich colours, has its wings raised perpendicularly when at rest; indicating, by its great mobility, volatile manners, and boundless liberty, the essence of its being.

Next come Bees, with few brilliant qualities, but they gain, by being known, while the butterflies please at first, and then become tiresome. Nature, preparing to form subjects which can chew and consume solids, only gradually reaches that end. The bee draws up the honey from flowers with its sucker, but tears the fibres with its mandibles, merely rough-sketched jaws. The wasp differs little from the bee. The ant has small smooth eyes, and twelve or thirteen joints form antennæ, very delicate instruments for the touch; the termes is much similar.

The crabones, much like ants, differ by their mandibles split at the point. The chrysides have their mandibles straight, four antennulæ, and distinguished by metallic colours. The ichneumon has split mandibles, like crabones; indented in the evanias and aroceras. Here disappears the augur of the females. The phrygaras, ascalaphi, and myrmeleons have no sucker, but possess together mandibles and jaws, characters common to all the succeeding families of insects; yet, in the ephemerals, to whom a day is a century, and the setting sun a phenomenon, instead of stings and augurs, are hooks, which facilitate propagation.

The head, whose forms and parts are very varied in each species, joins the corslet, by the immediate enchasing of the solid pieces, or by a ligament. In the scarabæus, lucuna, capricorn, &c. they are smooth tubercles, which fit into the cavities of the corslet, and render the head moveable from before, backwards; in the weevil, the posterior part of this is rounded, and enters into the anterior and concave part of the corslet, where it turns on its axis. In the fly, asilus, &c. the head and corslet, flattened in their corresponding faces, are soldered together by a projecting tubercle. The articulation of the attelabe differs from the weevil, in the cavity of the corslet having a scollop at its inferior edge, which leaves the head only the motion of a hinge. The junction by a ligament, is only remarked among some insects with four wings, whose head, entirely free, is restrained only when lifted up. Raising muscles situated above the corslet, and others depressing placed below, execute, by their alternate play, the divers movements which each mode of articulation allows.

The corslet, between the head and breast, yet little apparent, supports the first pair of legs; above it is a thorny scutcheon, and below, a ridge, both prolonged backwards, to strengthen the play of the wings. The abdomen, of several rings, resembles most the body of the caterpillar, being covered with a supple skin. In the urocera, the abdomen joins the breast; but is separated in ants, wasps, &c. and is generally terminated by horny pieces.

All insects have six legs, their forms and proportions regarding the destined life and actions of the animal; the legs are hollow, composed of four horny pieces, articulated one on the other—the haunch, thigh, leg, and tarsus. Attached to the corslet and breast are muscles, to move these members and the wings; those of the latter are one sort, slender and short, and cause the extension and folding, the separation and horizontal approximation;—the others, longer and stronger, rise and fall for flight. The arachnides differs in conformation from insects, being more varied in the number of parts and mode of articulation. In several species, the covering is soft; but always a portion of the corslet or breast is of strong consistence, to support the articulations and soft parts. The muscular system of insects and spiders is divided, so that each region of the body can be moved in particular, and the centre of gravity be changed, at the will of the animal.

The crustacea have the body all of a piece, and only displace it by moving their tail and legs. The covering is a calcareous crust, less flexible and more brittle than that of insects, often thicker, and mostly covered with asperities, tubercles, and thorns; extending over the surface, and confounding in one mass all parts of the trunk. The tail, the most powerful instrument in th disposal of the crustaceous, is composed of laminæ, which slide one over the other; or of rings joined by membranes. In craw-fish, the muscular apparatus consists of two masses of fibres, whose divers threads intertwisted, act obliquely on the parts of the tail destined to move. The legs are in four pieces, like those of insects, and articulate also in ginglyms; the same individual has often legs terminated in a pincer, a fin, and a moveable tail.

All the muscles of vertebral animals terminate in a tendon, or threads, on one side confounded with the muscle, and on the other attached to the other, wherein the moveable parts play when the tendon is drawn by the muscle. The annelides have, like worms, a bag formed of a single contractile muscle. But the nereid, lumbrici, &c. have two sorts of muscles; one, extended along the belly and back, constitute the mass of the body, and are interrupted by layers of a very close cellular tissue; the others terminate in the tufts of silk, hairs, tubercles, or thorns, seen on the surface by the play of the same muscles. This conformation has analogy with that of the hairy snail, and produces similar motions.

The molluscas have a muscular system partaking both of worms and insects. Their body is covered with a muscular *cloak*, which holds to a calcareous shell, the skeleton, which serves for the insertion of the moving muscles; some species are without shell, but have horny parts for the same purposes. When the shell is double, the valves articulate like a hinge, and are united by an elastic ligament, which tends to separate them. The mantle is open before, in oysters, mussels, &c.; at the two extremities, in the pholas, solens, &c.; and in the ascidius, it covers the body. Many of the molluscas transport their shell, by a mass of fibres named the *foot*, taking all sorts of forms, according to the manner in which the muscular threads contract and lengthen. The foot, in the muscle and pinna marina, resembles a tongue, with a furrow serving a finner to the byssus. Those without feet remain fixed, and can move the pulp of their body only by the cloak. The bag of the sepia, culmar, and sea-polypus, is comparable to the latter; compressible by layers of longitudinal fibres, transversal externally in the middle part, and oblique internally. The body has some solidity, on whose sides are implanted two muscles, as a fastening to the bag. These animals have several arms, moveable by numerous muscles, and provided with hollow and dilatable tubercles, to fix them on whatever they meet.

The larva differs in nutritive functions from the insect; the mutation is analogous to the kind of life fit for one or the other. A larva that feeds on vegetables, is replaced by a carnivorous insect; and an herbivorous insect originates from a larva which devoured flesh. The species which live on prey have the intestines short and thin; and those which take a less substantial food, have a complicated digestive apparatus, either from the length and twisting of the conduits, or their respective position and manner of communication. Thus, in insects which undergo a complete metamorphosis, if the mode of nourishment changes, the digestive apparatus undergoes analogous mutation. Those which have only a demi-metamorphosis, present only slight modifications.

Among these animals, some have a single stomach, others double, others multiple. If the animal pumps up the juice of flowers, as the bee, butterfly, &c. its stomach is membranous and dilated; it is muscular, if it lives on blood, as the bug and water-bug; it is without any swelling, if the animal gnaws wood or leaves, as the scarabæus and may-bug, &c. The stomach is double in all insects which devour flesh. The first, muscular, is a sort of gizzard; the second, membranous, is a long canal, with the pill or velvet exterior: and, those insects which feed on fresh herbs have a multiple stomach, like the ruminators, and can likewise regurgitate their food. The first stomach, or the paunch, is rounded or membranous; hence the aliments are brought back to the mouth. The second, smaller, is connected with the other by a very short gut. Besides its muscular sides, it is furnished interiorly with small denticulated laminæ, which, aided by the peristaltic motion, complete the grinding of the mass. The two other stomachs are spongy, and terminate in the duodenum; as in the mole-cricket and locust.

The œsophagus, which leads to these stomachs, is straight and short; the intestines, where they terminate, vary in length and diameter. The canal opens into a cloaca, or cavity, concealing the sexual organs. The peritoneum covers the exterior sides of the whole alimentary canal. In the larvæ are epiploons, or portions of cellular tissue filled with fat, destined to sustain the animal, when, in the course of its metamorphosis, it can no longer take its food externally.

Corallines unite the vegetable with animal existence.—The Tremellas, Nortocs, and crowds of Infusoria, feed by inhibition; have a cavity in which the aliments are digested, the residuum passing in vapours by the pores. Among the animalcules, the aperture of the stomach may be distinguished in some of the largest: they sometimes swallow smaller animalcules, but disgorge them quite alive; whence, it seems, matters dissolved in water are the only aliment suited to their digestive organs.

The Polypi have a stomach, whence branch five tubes, at once vessels and intestines; at first, they rise above half the body of each, become more thin, and terminate in a general canal, or at the stalk of the polypier, by joining and intertwisting with similar tubes from the other polypi. Thus the food taken by each benefits all—a tree, with mouths instead of roots, vessels instead of fibres, and stomachs where the aliments digest, instead of cells to filter the juices. In the naked polypi, as the hydras, the gelatinous pulp is a bag, wherein the aliments are imbibed, and digested similarly to the infusoria.

The stomach of the Medusa rhozotomas has some analogy to that of the polypi, hollowed out in the pedicle of these animals, and many vessels thence ramify in the whole mass, and supply nutriment. The mouth is broad and rounded in the medusa; it is composed of pierced tentacula in the rhozotomas, the small canals forming four great trunks, which go into the stomach. The pyrotomas have a digestive system similar to that of the hydras.

The Sea-star has a round and membranous mouth, terminating in a bag amidst the radii, which each receive two vessels or cœcums fixed by mesenteries equally membranous, and divided into fine branches, as in the medusas, always twice the number of the radii. They do not exist in the ophium, whose radii, very numerous, are elongated, like a serpent's tail.

The Sea Urchin, whose stomach resembles that of the ophiura, has in its mouth five osseous teeth, enchased on a very complicated apparatus, composed of fixed pieces, and others moveable by twenty-five muscles, which act immediately, and ten others which concur in the same end, by the intermedium of five corresponding ossicles.

All these ossicles have only one opening in their alimentary bag, and eject their ordure by the pass which receives the food. But, in the Holothurias, the stomach, longer than the body, and bent back on itself, terminates in a cloaca backwards, separated by a valve. The sipuncle has a thin stomach, many times as long as the body, entirely bent back, and opens in the anterior part, the anus being very nigh the mouth. As the obligation of nourishing themselves is common to all beings, it was necessary that all should have organs destined for this function, and it was only requisite to modify progressively the tissues of which they are composed. In like manner, these organs, unable to exist without a common covering, have a thin pellicle, a suberic or horny epidermis, which, slightly varied from one species to another, fills, in reference to all, the same functions and services.

Most of the Infusoria executing rapid and spontaneous movements, the gluten is supposed to have taken the consistence of fibrine. Provided with a muscular tissue, they can move more freely, according to the impressions which the media occasion in this tissue eminently contractile. In the rotiferous, this tissue presents a better organization. In the centre of the gelatinous pulp is a point, susceptible of contraction, which is the stomach, and is exerted according to the aliment received. From this point numerous fibres proceed, and anteriorly set in motion little beards, with such rapidity as to resemble that of an artificial wheel; and, by this whirl, matters dissolved in the water are brought into the stomach. In the posterior part, the fibres terminate in a sort of trident, which, susceptible of contraction, serves as an anchor to fix the animal, when it is not willing to be forced along by the current.

The tentacula of the Polypi move by curious springs, but very slowly; being susceptible of lengthening, contracting, and separating in all directions. In the state of rest, they float in the midst of the liquid, like the fibrous roots of aquatic plants. The animal often swallows them with the aliment, but they come out intact from the abdominal cavity. The Actinias have a membranous skin, contractile in every point, which allows them to take all sorts of forms. The Sea-anemone has a body as flexible as its numerous tentacula. The Medusas, or Sea-Nettles, have very singular movements; sometimes they fill certain muscular canals, that are on the surface of the skin, with a liquor which swells them and brings the body a little forward; sometimes they detach themselves from the rock, and turning on their back, push out a sort of gluey horns, whereby they take the bodies they meet.

Every species among these animals offers curious details. The Sea Hedge-hog has a crustaceous skin provided with tubercles, in which are moveable thorns; between the tubercles are holes, from which the animal puts out filaments, which it uses like feet; yet, with all this apparatus, its loco-motion is slow and confined to some tumbles. The rays of the Asterias contract, and are furnished with feet ranged in several rows their whole length, and serving for the same purposes as those of the Sea Hedge-hog. The Holothurias, by similar means, lengthen or contract their coriaceous skin. The organs called feet, in these animals, are retractile suckers; they represent tubulated ampullæ, filled with a liquor, which it causes them to displace themselves, according as it goes to either extremity of the tube.

The invertebral families have new organs, and a more complicated mode of existence. There is an external skeleton, horny in insects, stoney in the crustaceous, and animals with shells, coreaceous and viscous in the molluscas and worms. On this skeleton are the different parts of the body jointed; the muscles have their point of insertion, and all the motions relate to it as to a centre. This general disposition is greatly modified and varied in the different species.

Worms have no skeleton, but their skin is very thick, and has the consistence of wet parchment. One muscle without interruption forms most of this skin, and makes the animal into a sort of contractile bag, which moves sometimes by the alternate opposition of the two extremities furnished with a fleshy disk, and sometimes by the slow progression of the folds, which the animal makes its skin contract in sticking by the suckers of its mouth. These two kinds of motion make little difference between worms and the preceding families.

The larvæ, or caterpillars, have more relation with worms than insects. Their body, annulated, is covered with a flabby and soft skin. Muscles from one ring to another, make them slip along alternately, and thus the caterpillar crawls, rather than walks. Most insects with two wings are in this case. The larvæ of flies, œstra, tipulas, &c. have the rings provided with hair, which makes their motions less difficult. Others, among the insects with four wings, have, very near the head, and below it, six legs articulated in three pieces, the last of which, terminated like a hook, allows the larva to cling to any thing, and draw after it the extremity of the body. These legs are so short in the larvæ of the capricorns, that they are almost useless to them; but they supply for this by mandibles, which serve to hollow out furrows, along which they climb; and some, as the gall insects, besides these six legs, have others, not articulated, inserted immediately on the skin, and sufficiently moveable to facilitate the play of the rings.

Though this play is very confined in all larvæ, nevertheless it is less so than in worms, and their motions are, in comparison, more agile. This difference comes from the muscular apparatus being more complicated in the larvæ. It does not form a continued tissue, as in worms, but distributes itself into several longitudinal bundles of fibres, oblique and transversal, which, having their point of insertion in divers parts of the body, allow contractions more varied and independent. This disposition of the muscular tissue is better developed in insects. No animals, even in the superior classes, have organs better appropriated to the divers media in which the movements are operated. A horny elastic covering composes the skeleton, and supports the soft parts, formed of many pieces, which, articulating one with the other, can move themselves separately.

The spiders (*arachnides*) have a digestive system similar to that of other insects. The crustacea present some remarkable peculiarities. Their organs of mastication are more muscular, numerous, and strong. The alimentary canal presents no other swelling but the stomach, without winding. This swelling, in craw-fish, crabs, &c. is supported by a bony shell, so that it does not sink when empty. Five teeth, implanted in this shell, and moveable, supply the want of muscular pressure, and execute in this stomach a real mastication. The muscles which move them, play at will; a fact unexampled in the internal functions of the digestive organs, whose action is always determined by the presence and the nature of the aliment. This singular stomach is placed in the thorax. The œsophagus is short and very broad; the intestine is, on the contrary, very slender, and quite to the extremity of the tail, where it opens. The other crustacea have interior teeth, but the stomach is not bony.

The annelides differ not from worms with respect to nutrition. Some molluscas have horny jaws, others stoney, planted in a fleshy mass, whose fibres are not very distinct. Some, as the whelk, murex, &c. have a trunk instead of jaws. All have salivary glands in the fleshy mass, secreting a humour which mixes with the aliments. The molluscas with jaws have, similarly to the crustacea and insects, a motion of the lips for deglutition. Those which have a trunk, draw it within their body, like the finger of a glove turned in, a motion peculiar to most of these animals, such as the horns, &c. and which is operated by means of very fine and longitudinal muscles, fixed on one side to the sides of the body, and on the other to the internal sides of the trunk or horn. Some molluscas have, moreover, a very singular tongue, formed of a membrane covered with thorns or asperities, directed backwards, varied in form and position, but it always excites a peristaltic motion, by the bending and rising again of the thorns.

The molluscas have a very short œsophagus, and a membranous stomach enveloped by the liver, (replaced in the crustacea and insects by hepatic vessels,) very large, of a bright brown oval mass, situated near the back towards the head, and divided into two lobes; each having an excreting conduit, that pours an orange-yellow bile into the stomach. The number of the lobes is very variable, but each has always an excreting canal.

The digestive apparatus of these animals is as singular as that of the crustacea. In the stomach of the acephalous are cartilaginous pieces, whose use is entirely unknown. Sometimes the stomach is single, and the intestine short, as in the ascidias; or double, and the intestine makes numerous circumvolutions, as in the oyster. The molluscas, which creep on the belly, and whose shell is univalve, present, with respect to the alimentary canal, the same variety as insects. The slug has an œsophagus, which, in dilating, forms a sort of craw; the stomach is an oblong membranous bag, which receives the great hepatic vessel. The intestine, always equal, makes two folds and opens beside the neck. The bulimus of ponds, has a muscular stomach, comparable to the gizzard of birds.

The onchidia, besides the craw and gizzard, has two membranous stomachs. In some species we find the apparatus of the ruminators; in others, the divers stomachs are armed with stony pieces. The sepia, with its mouth between the feet, walks with its head down, and brings the food up again; having a craw and a gizzard, stronger than the preceding species, separated by a pylorus from a spiral third stomach; a second pylorus is between this stomach and the very broad intestine which opens into a funnel-shaped cloaca, through which pass the genitals and the black liquor which the animal sheds. In the molluscas, the position of the anus varies much; while in worms, insects, arachnides, crustacea, and annelides, it is always opposed to the mouth, and below the body.

LECTURE LXXXVI.

COMPARISON OF THE ANALOGY AND DIFFERENCES OF ANIMALS, BIRDS, AND FISHES.

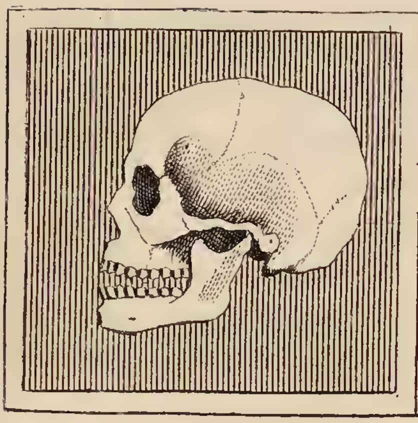
> Look round our world; behold the chain of love
> Combining all below, and all above.
> See matter next, with various life endued,
> Press to one centre still, the general good.
> See dying vegetables life sustain,
> See life dissolving vegetate again:
> All forms that perish other forms supply,
> By turns we catch the vital breath, and die;
> Like bubbles on the sea of matter borne,
> They rise, they break, and to that sea return,
> Nothing is foreign; parts relate to whole;
> One all-extending, one preserving soul,
> Connects each being, greatest with the least;
> Made beast in aid of man, and man of beast;
> All serv'd, all serving; nothing stands alone;
> The chain holds on, and where it ends, unknown.
> Cease then, nor order imperfection name,
> Our proper bliss depends on what we blame.
> All nature is but art, unknown to thee;
> All chance, direction, which thou canst not see,
> All discord harmony, not understood;
> All partial evil, universal good.
> And spite of pride, in erring reasons spite,
> One truth is clear, *whatever is, is right.* POPE.

THE classes of fishes, reptiles, birds, and quadrupeds, are called vertebrated animals. All of them, however different their external form, or the nature of the element they inhabit, exhibit a remarkable analogy in their internal conformation. That part of the skeleton which exists in all these animals, and appears essential, is the spine, or that series of connected bones called vertebræ, extending from the head along the whole length of the back. The peculiar mechanism of the spine renders it capable of answering a variety of important purposes in the animal system; and its several modifications of structure in different tribes, adapt it to the circumstances in which they are placed, and to the various intentions of their formation.

Aquatic animals present the simplest mechanical conditions, with reference to loco-motion. In fishes, the buoyant force of the surrounding fluid, by counteracting nearly their whole weight, supersedes the need of limbs to support the body, which land animals require; and the progress of a fish in water is effected principally by the muscular action of the tail, which, giving powerful lateral strokes, propels the animal, on the same principle as a boat is moved in sculling. The modifying and regulating powers belong to the fins. The hydrostatic principles on which fishes ascend or descend in water, are by the dilatation or compression of the air-bladder. The air-bladder in fishes may be regarded as a refined apparatus in the body, expressly accommodated to the laws of hydrostatic pressure; and furnish one, out of many instances, where philosophical principles have been applied, with manifest art and intention, to effect a particular purpose in the economy. Those flat fishes without air-bladder, have this want compensated by the great size and power of motion in the pectoral fins, which enable them to strike the water from above, downwards, with considerable force. In the whale, and other cetaceous animals, the body is rendered specifically lighter, by its vast contents of oil especially accumulated about the head, which part is continually required to be raised above the surface, for the purpose of respiration.

Serpents and reptiles having short and imperfect feet, the former advance with various degrees of rapidity, and derive advantages from the position of their scales, and the connection thereof with the ribs. The tortoise, frog, lizard, and various similar animals, form links in the chain of gradation to the more perfect conformation, with reference to rapid progressive motion, which exists in warm-blooded quadrupeds; whose body, raised higher on the limbs, enjoy a greater range of motion, and require a less frequent repetition of steps in traversing an equal space. The different proportions in which the fore and hind extremities sustain the weight of the body, their number of component levers, their relative obliquity, the mode in which the muscular force is disposed, and the combinations of action which result, are subjects of astonishing peculiarity. The paces of quadrupeds are distinct and obvious, such as walking, the trot, gallop, amble; bounding of deer, springing of beasts of prey, undulating pace of the cameleopard, and peculiar progressions of animals formed for leaping, as the hare, jerboa, and kangaroo. The next gradation is in the structure of the hind foot, which, in monkeys, approaches near to the human structure. The great distinctive features between the mechanism of the frame of man and quadrupeds, are derived from the former being adapted to the maintenance of the erect posture. In man, the attitude of standing is a position of less security than it is in quadrupeds, and is maintained by a succession of actions, by which the centre of gravity is perpetually moved from side to side; its tendency to fall in any one direction, being immediately counteracted, by small and insensible movements in the contrary direction. The human arm, exempted from the office of supporting any part of the weight of the trunk, may be employed exclusively as an organ of apprehension; and there are circumstances in the structure of the several joints of the limb, and more especially of the hand, which render it so admirable a mechanical instrument. The passage of the tendons which bend the last joints of the fingers, through a perforation in those employed to bend the middle joints, affords a particular example of artificial contrivance.

The progressive motion of birds is very interesting: that an animal may possess the faculty of flying, two principal conditions are required; great strength of muscle, to produce sufficient velocity of motion in the wing; and great extent of surface in that part of the wing destined to act upon the air. Of the mammalia, only the bat has sufficient muscular power of limbs, however assisted by an expansion of surface, to strike the air with the velocity requisite for flight. Some quadrupeds, reptiles, and even fish, possess the power, always very limited, of advancing through the air: in the bird alone, we find the most perfect adaptation of structure to the purposes of flight. The frame of their skeleton, the position and figure of the wings, the situation of the muscles, and the mechanism of their action, have an express relation to the element in which nature intended them to move; and there are various modifications which these circumstances present in the different orders of birds. The minute structure of the feathers,



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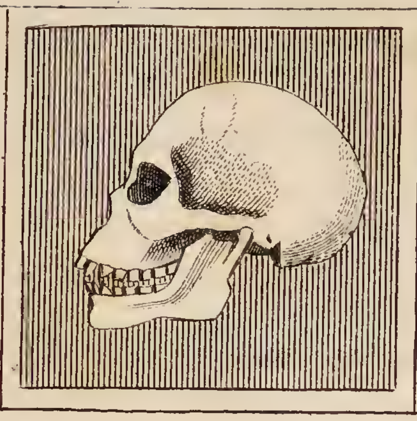

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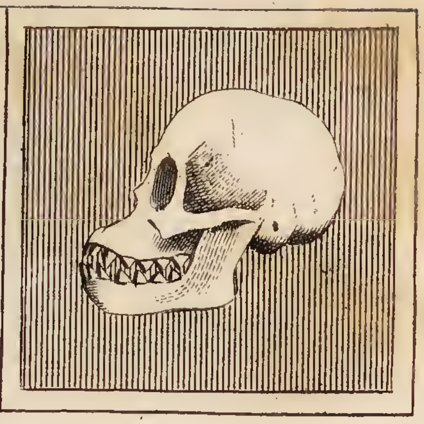

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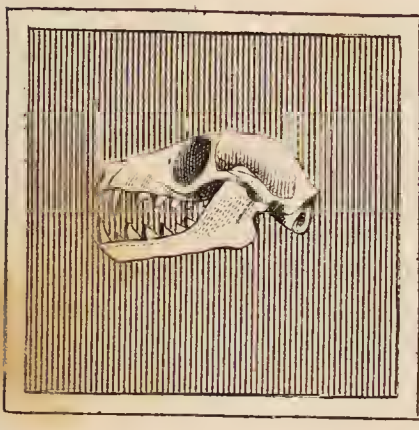
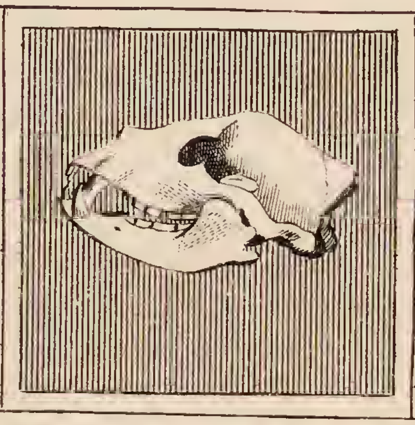
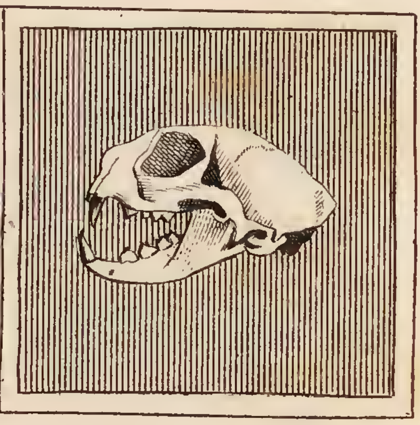


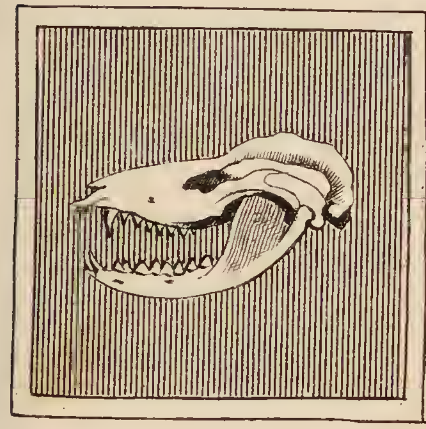
Bat



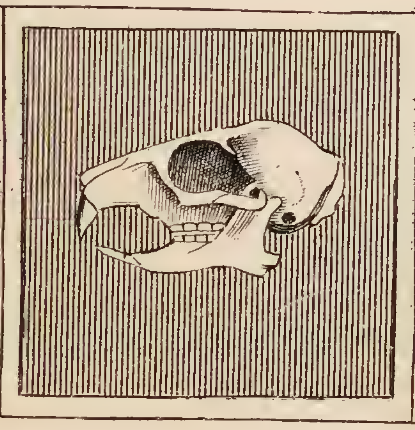
Bear



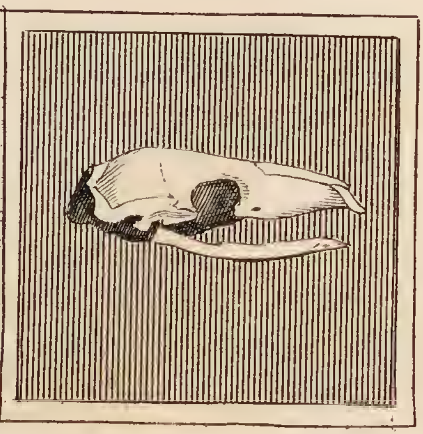
Cat



Opossum



Squirrel



Ant

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investigated by the microscope, appears highly curious, and exhibits a singular refinement of art in the means whereby their fibres are mechanically locked into each other, so as to preserve a continuity of surface. To which may be added, the singular mechanism by which birds sustain themselves by one foot on their perch, when they roost.

All living bodies with which we are acquainted, are constructed nearly on the same plan, possess similar organs and functions, and being modified only according to those circumstances which have given occasion to their artificial arrangement into class, order, genus, and species, contribute much to illustrate each other. In one animal, for instance, an organ is small, its structure complicated, or its use obscure; while in another the analogous organ is large, its structure simple, and its function obvious. Had it not been for the attention paid to these differences, many discoveries which have been made in human anatomy would still have been unknown, had they not been previously made in comparative anatomy.

On comparing animals in the most general point of view, we find that many have an internal articulated skeleton, the principal basis of which is a vertebral column; and that many others have either no articulated skeleton, or one that is external, and has no vertebral column, spine, or back-bone.* Hence animals have been divided into vertebral and invertebral animals. Again, we find, on comparing together the vertebral animals, that some of them possess a heart with two ventricles, and that their sanguiferous system contains warm blood; while others have a heart with only one ventricle, and a sanguiferous system containing cold blood, or blood whose natural temperature scarcely exceeds that of the medium in which they live. Thus, we have two divisions of the vertebral animals, and these we may again subdivide; the former according to their mode of generation, the latter according to their mode of respiration. Thus, of the vertebral animals, with a double heart and warm blood, some are viviparous, and suckle their young by mammæ or teats. These animals are called MAMMALIA. Others are oviparous, and do not suckle their young. These are the BIRDS. Of the vertebral animals, with a single heart and cold blood, some possess lungs, as REPTILES and SERPENTS; others breathe by means of gills, as FISHES.

On comparing the invertebral animals, or those having no back-bone, we find that some of them have an external articulated skeleton or case, while others have neither skeleton nor articulated members. These two divisions of the invertebral animals may be subdivided according to the greater or less complexity of their organization. Thus, of the invertebral animals with an external articulated skeleton, some have a circulating system, and breathe by *branchiæ*, and their skeleton is generally calcareous. These are called the Crustacea. Others have no circulating system, but breathe by *tracheæ*, and their external covering is horny. These are the Insects. Again, of the invertebral animals without skeleton or articulated members, some have simple nerves, *i. e.* nerves without knotty protuberances, as those animals which we call Mollusca; others have knotted nerves, as Worms; while several have no appearance of nerves, and are called Zoophytes.

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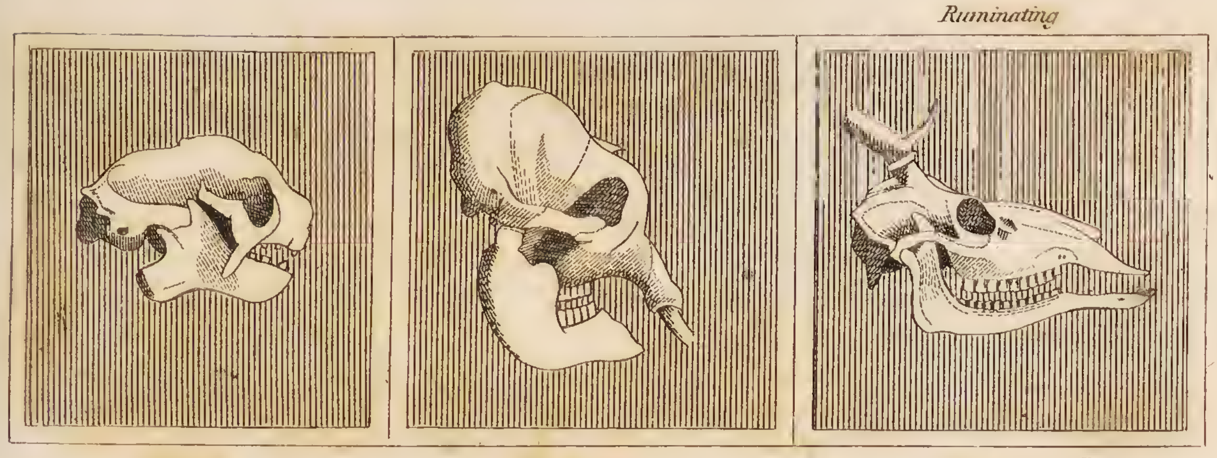
* For some technical terms in this article, we must refer the reader to the descriptions of our anatomical plates, and to his dictionary, but we have avoided them as much as possible.

Thus we obtain ten groups or classes of animals, according to the following tabular sketch.

VERTEBRAL ANIMALS.	Having an internal, bony, or cartilaginous skeleton, and a brain.	A double heart and warm blood.	*Viviparous* with *mammæ*.	I. MAMMALLIA.
			Oviparous without *mammæ*.	II. BIRDS.
		A single heart and cold blood.	Having lungs and articulated members.	III. REPTILES.
			Having lungs but no articulated members.	IV. SERPENTS.
			Having gills and fins.	V. FISHES.
INVERTEBRAL ANIMALS.	Having no internal skeleton, and no brain.	With articulated members	Having a circulating system, and gills or *branchiæ*.	VI. CRUSTACEA.
			Having no circulating system and *tracheæ*.	VII. INSECTS.
		Without articulated members	Having simple nerves.	VIII. MOLLUSCA
			Having knotted nerves.	IX. WORMS.
			Having no nervous system.	X. ZOOPHYTES.

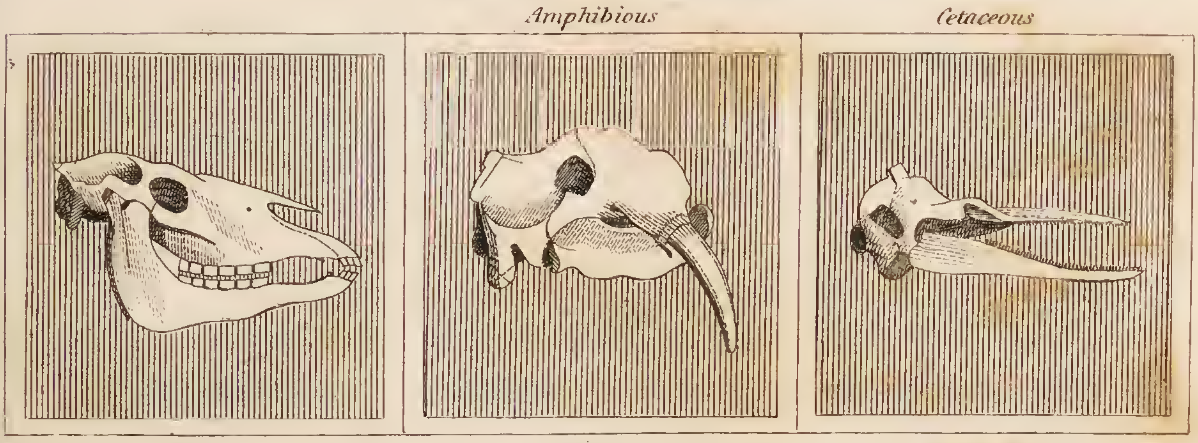
The Mammalia agree in having four articulated members, two atlantal and two sacral, though the latter, in many cases, and both in one order, are concealed below the integuments, so as to resemble fins. They have two articulating condyles in the occipital bone; their brain completely occupies the cavity of the skull, and is very complicated. Their internal ear has at least three articulating bones, and a spiral *cochlea*; only their lower jaw is capable of motion; their larynx is furnished with an epiglottis; a muscular

COMPARATIVE ANATOMY


Ruminating

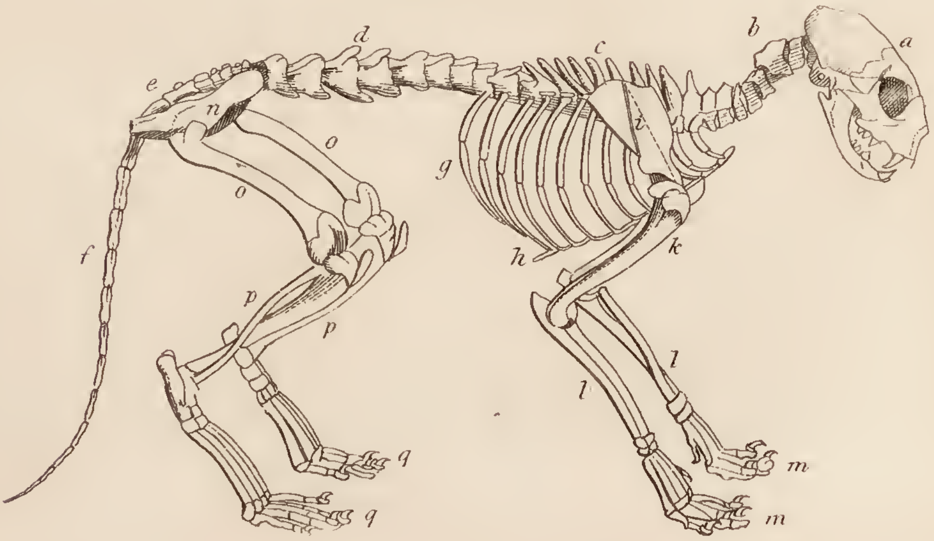
Sloth Elephant Stag

Skulls of Animals.


Amphibious Cetaceous

Horse Seal Dolphin

Skeleton of a Cat



a Head
b Vertebræ of the neck
c Vertebræ of the shoulders
d Vertebræ of the back

g Ribs
h Sternum
i Shoulder blade
k Thigh bones

n Hip bone
o Thighs of the hind legs
p Legs
q Feet

diaphragm is placed between the chest and belly, and there is an omentum covering the intestines on the sternal part of the belly. Their chyle is white, and passes through mesenteric glands, and their skin is more or less covered with hair.

The animals of this class differ in the following general circumstances. The greater number have nails or claws upon their extremities; some have their extremities terminating in hoofs, while a few have them formed like fins. These three divisions may be subdivided, the two first according to the number and situation of their teeth, and the last according to the situation of their nostrils. Thus, of the *mammalia* with nails or claws, some have three sorts of teeth, and of these *mammalia*, one family has thumbs on the atlantal extremities only, as man; others have thumbs on both atlantal and sacral extremities, as the *quadrumana;* while a third family has no separate thumbs or great toes on the atlantal extremities, as the *cheiroptera*, that have membranes, extended between the divisions of at least their atlantal extremities; the *plantigrada*, that have no separate thumbs, and rest on the ground with the whole sole of the foot; the *carnivora*, that have no separate thumbs, and rest on the ground only with their toes; and the *pedimana*, that have separate great toes on the sacral extremities. A second subdivision of the *mammalia*, with nails or claws, wants at least one sort of teeth, and of these there are three families, viz. the *roduntia*, that want only the canine teeth; the *tardigrada*, that want only the cutting teeth; and the *edentata*, that want both the cutting and canine teeth.

Of the *mammalia* with hoofs, some have more than two toes, or more than two hoofs, as the *pachydermata;* others have two toes and two hoofs, as the *ruminantia;* and a third family has only one toe and one hoof, as the *solipeda.*

Of the *mammalia* with feet formed like fins, the animals of one family have their nostrils at the extremity of the muzzle, as the tribes of *phoca* and *trichecus;* while those of another family have them seated in the coronal part of the skull, near the frontal bone; as *cetacea.* Birds agree in having their atlantal extremities (with few exceptions) formed for flying; in having a single condyle to the occipital bone; a very large sternum; a brain that completely fills the cavity of the skull, but is not very complicated; three eyelids; no external ear, and the internal ear with only one loose bone, and a conical, but not spiral *cochlea.* Their jaws or mandibles are covered by a horny substance; their chyle is transparent; they have no mesenteric glands, and no omentum; their lungs are attached to the cavity of the chest; there is no diaphragm; their trachea is furnished with two larynxes; they have no epiglottis, no urinary bladder, and a single ovary and oviduct.

The principal differences, according to which birds are arranged, respect the position and connection of the toes; the form and consistence of the bill; the structure of the head and neck, or that of the wings. From the first of these circumstances, Cuvier divides them into six orders; viz. ACCIPITRES, having short feet, the toes furnished with strong claws, and a hooked bill; PASSERES, having three toes before, and one behind, with the fibular toe of the former either wholly or partially united to the next; SCANSORES, having two toes before and two behind; GALLINÆ, having the *rotular* or fore-toes united at their base by a short membrane; GRALLÆ, having elevated and naked *tarsi*, and the two fibular toes united; and ANSERES, having the toes united by broad membranes. The first four of these orders are *land-birds*, the two last *water-birds.*

In FISHES the brain is extremely simple, and by no means fills the cavity of the skull; their ear has no *tympanum*, and no external organs; both their jaws are moveable; their heart consists of one auricle and one ventricle; they breathe by means of gills; have neither wind-pipe nor larynx, and their nose is not connected with the organs of respiration. They have no pancreas, and no urinary bladder. The male has two testes, and the female two ovaries.

The general differences in the structure of fishes, respect either the consistence of their skeleton, or the position of their fins. From the former circumstance, they are divided into bony fishes, in which the skeleton is bony; and cartilaginous, in which it is gristly.

The cartilaginous fishes are distinguished, according to the structure of their gills, into two orders; *chontropterigii*, in which the gills are fixed, and have no coverings; and *branchiostegi*, that have the gills free, and furnished with covers. The bony fishes are distinguished according to the situation of their fins, into four orders. In the first there are no ventral fins, and these fishes are called *Apodes*. In the second order, the ventral fins are immediately below the thoracic fins, and these are called *thoracici;* in the third order, the ventral fins are situated caerad of the thoracic, these are the *abdominales;* and in the fourth, the ventral fins are atlantad of the thoracic, these are the *jugaleres.*

The organs of Motion differ considerably in the various classes of animals. In many they are as distinct as in man, and much more powerful in proportion; while in others, though the phenomena of motion are very apparent, the organs by which it is produced cannot be with certainty ascertained.

The general differences of the bony system which constitute the distinguishing marks between the *vertebral* and *invertebral* animals need not be here repeated. The composition and structure of the bony system are extremely various. In the MAMMALIA, the texture of the bones is seldom so fine and delicate as in man, though it is for the most part proportionally stronger. In some species, the fibres are much more loose, and the cellular texture more distinct than in man. This is particularly the case with the CETACEA. The bones of BIRDS have much larger cavities than those of all other animals; but these cavities are filled with air instead of marrow. The bones of REPTILES and FISHES have a very homogeneous appearance; the gelatinous and earthy parts being very uniformly mixed. The bones of fishes have a large proportion of gelatinous matter, and in some tribes they are wholly cartilaginous. The horns of some animals, as the various species of *deer*, very nearly resemble the bones of the rest of the body, but those of other animals; as the *cow*, the *sheep*, &c. have a superabundance of gelatinous and albuminous matter, and are formed of plates lying over each other, not being of a reticulated structure, as in the former. The shelly covering of the *turtle* tribe nearly resembles these latter horns. The shells of the *testacea* have a great proportion of earthy matter, but this is chiefly *carbonate* of lime, while the earthy part of the bones of vertebral animals is *phosphate* of lime.

In all the Mammalia, in Cetacea, and in Birds, the muscular fibres are red, while in all the other classes they are white. The muscles of the Mammalia differ but little from those of man, except in being proportionally stronger in beasts of prey, and others that are accustomed to great exertions. In birds that fly, the muscles attached to the wings are most remarkable for their size and strength. The fleshy part of the muscles of birds is said to lose its irritability sooner than in those of other animals, and the tendons are more disposed to become bony. In reptiles, the muscles are fewer in number than in other vertebral animals; but some of them are of prodigious strength. In serpents, on the other hand, they are proportionally more numerous, but more thin and uniform. In most fishes, the muscles are disposed in layers, producing those flakes which we observe in the flesh of these animals when cooked. They are very numerous and large, of a uniform texture, and in general destitute of tendinous fibres. In the crustacea, the muscles are seldom very numerous, but those which move the large claws in the crabs and lobsters, are particularly strong and fleshy. Insects have generally a great number of muscular fibres, but these are not collected into fleshy bundles, as in other animals. The larvæ of insects are endowed with a much greater number of muscles than even serpents; some minute naturalists having counted in one larva above four thousand; and these, in several individuals, are possessed of immense strength.

All the mammalia, nearly all the reptiles, and all birds, have four articulated members. In several species of the tribes *phoca*, (seals), and *trichechus*, (walruses,) these members are indeed not very evident, as the *atlantal* extremities are often very short, and the sacral approach so near each other, and are thrown so far backward as to resemble the tail of a fish. Many of the mammalia have their atlantal extremities so formed that they can employ them like the hands of man. The *cetacea* have not properly four articulated members, as they have no bones in their tail fins; but in their pectoral fins the bony structure is very evident, and very nearly resembles that of the *atlantal* extremities in the mammalia. This is particularly the case in the *porpoise* and the unicorn fish, the extreme bones of whose pectoral fins very much resemble those of the human hand. Fishes can scarcely be said to have articulated members, though their pectoral fins are joined to the skeleton by a sort of *scapula*, and are very moveable. The number of articulated members in insects is usually considerable. Some have six or eight legs, while a few, as the *millepedes*, and the *scolopendræ*, or *centipedes*, have a much greater number. In the crustacea, besides the number of ordinary legs, there are two large and very strong claws.

The atlantal extremities of birds constitute their wings. All birds have wings more or less perfect, but they do not all employ them for the purpose of flying. In some, as the ostrich, the small wings are supposed to assist the animal in running; and in a few, as some of the penguins, they act as oars, to expedite their motion in the water, and are accordingly not feathery, but scaly. Most perfect insects have wings, but their number as well as structure varies in different tribes; and, indeed, it is from the number and structure of the wings that the orders into which naturalists have divided insects, are chiefly denominated.

The tail is in many animals an important organ of motion. To several species of quadrupeds and reptiles it answers the purpose of a hand; to birds and fishes it assists in regulating the motions given to their bodies by the wings or fins, while to many it affords an admirable weapon of defence.

There is a peculiar organ in most fishes, by which they are enabled to alter their specific gravity so as to sink deeper in the water or rise nearer to the surface at pleasure. This organ is called the swimming bladder, and has been arranged by Blumenbach, among the organs of respiration, though it certainly has nothing to do with that function, and seems intimately connected with the motions of the animals. This opinion is strengthened by the circumstance of its being largest in those fishes that swim with great swiftness. This organ is not found in the *chondropterygious* fishes, in several of the *brancheostegi*, or in flat fishes; and what is remarkable, it occurs in some species of certain tribes and not in others.

In no animal is the brain found so large, in proportion to the nerves which proceed from it, as in man; though many of the mammalia have a brain very similar in other respects to the human. Of these, the horse seems to have the largest brain; but Soëmmering has found that the largest horse's brain which he has examined is scarcely more than half the size of the smallest which he has seen in an adult man. Yet the nerves arising from the former were at least ten times larger than those from the latter. In a great many mammalia the *cerebellum* is separated from the *cerebrum* by a bony instead of a membranous partition. This portion of the *encephalon* is also in most quadrupeds larger in proportion to the *cerebrum* than in man, and the same is the case with the *medulla oblongata.*

The difference between the *cerebrum* and the *medulla oblongata* is most remarkable in the *cetacea*, especially in the dolphin, whose brain is fifteen times larger than the *medulla oblongata.* It is remarkable that the pineal gland in the brain of quadrupeds has very little of that sandy substance which is so generally found in the brain of man.

In the brain of birds there are several remarkable peculiarities. There are no circumvolutions like those of the intestines, as in the brain of man and most mammalia, and the parts called *fornix*, *corpus callosum*, and *corpora striata* are wanting. In birds also, the situation of the cortical and medullary parts is reversed, the former being the central and the latter the peripheral substance. The ventricles also are on the outside of the medullary substance. According to Cuvier, the brain of these animals consists of six tubercles, viz. two hemispheres, two optic *thalami*, a *cerebellum*, and *medulla oblongata*, all visible exteriorly.

With respect to the organs of the external senses, all the mammalia, cetacea, birds, reptiles, and fishes, appear to possess those of all the five senses, though not in an equal degree of perfection; that the senses of hearing and smelling are found in a great variety of animals, though we cannot always distinguish appropriate organs that are destined to the exercise of these senses; that feeling is perhaps the most generally diffused of all the senses, and that sight is wanting in a great many animals.

The beaks of birds probably supply to them the want of a more delicate feeling organ. We know that in many species, especially geese and ducks, the beak is abundantly supplied with nerves, and is covered with a very delicate membrane; and there is every reason to believe that these birds, in dabbling among the mud for their food, are directed in the search by the delicacy of this organ.

It has not been ascertained by anatomists whether reptiles have any appropriate organs of touch; but probably most of those with naked skins, as the frog and lizard, employ their skin for this purpose, and to some the tongue appears to perform the same office. The skin of serpents is supposed to be unusually sensible, and is considered by many as their only feeling organ.

Many fishes possess a very acute feeling in their belly and their lips, and some of them are furnished with worm-like tentacula, which they half conceal in the sand, and by means of which they receive notice of the approach of their prey.

A great many of the mammalia, especially the tribes of weasels, bears, dogs, and cats; the elephant, the hedgehog, and the mole, possess the sense of smelling much more acutely than man; and on examining their nose, we find that the structure of the ethmoid bone is much more complicated; that its convolutions are much more numerous than in most other animals. Hence the pituitary membrane in these animals has a much greater extent of surface, and admits of a much greater number of nervous ramifications being distributed to that organ. The elephant seems peculiarly fitted for delicacy of smell; for besides the trunk, the external perforations of which are evidently intended for nostrils, and which is abundantly supplied with nerves, its frontal sinusses are remarkably large and extensive.

Most classes of animals appear to possess the faculty of hearing; and in all the superior classes, including mammalia, cetacea, birds, fishes, reptiles, and serpents, the auditory organs are sufficiently apparent. Insects can doubtless hear; but it is uncertain by what organs they exercise this faculty. Many of the crustacea have very evident internal auditory organs, which have been described and figured by professor Scarpa. Some of the mollusca, as the *sepiæ*, have something like an auditory organ; but in all below these, this organ seems altogether wanting.

In birds, as in all the following classes, there is no external ear, but there is in this class an exterior opening, which in some, as the owls, is covered with a valve. The membrane of the tympanum in birds is convex on its peripheral surface. It is remarkable that birds have the internal cavities of the two ears connected by the air-cells of the skull. The labyrinth in this class has only one little bone, placed between the membrane of the tympanum and the *fenestra ovalis*, and the eustachian tubes communicate by a common opening with the arch of the palate. There is in birds no proper *cochlea*, but instead of it, a short, blunt, hollow, bony process, that passes from the vestibule obliquely backwards, and is divided by a partition into two scalæ, terminating like the winding passages of the cochlea in man and mammalia.

In fishes there are three large semicircular canals projecting into the cavity of the skull, and opposite to that part of the vestibule where the auditory nerves terminate, there are generally found two or three small bony bodies, resembling those of serpents, but generally of a harder consistence. In some of the cartilaginous fishes, there is also a tubular cavity resembling a *tympanum*.

The only part of the organs of hearing that is universally found in mammalia, cetacea, birds, fishes, reptiles, serpents, and in some crustacea and sepiæ, is a gelatinous pulpy substance filling up the internal cavities, and having the ramifications of the auditory nerves distributed through it. We are therefore warranted in concluding, that this pulpy matter is the essential organ of hearing in all these animals.

The cuticle of Mammalia differs little from that of man, except in its disposition and its appendages. In some quadrupeds it is generally thick, and marked on the surface with numerous furrows, or wrinkled into several remarkable folds, as in the elephant and rhinoceros. In other *mammalia*, again, as the porcupine, it is extremely thin, and scarcely to be distinguished from the more central layers. In a few species, the cuticle of part of the body is of a scaly structure, as in the tail of the beaver, and the tails of several animals which employ that organ to lay hold of bodies, as rats, some monkies, and the prehensile porcupine. In a few species, as the pangolins, or scaly lizards, and the armadillos, the cuticle is entirely scaly; and in the former the scales are susceptible of erection, by the action of that particular subcutaneous muscle which we shall notice presently.

The cuticle of Fishes is also entirely scaly, and so soft and viscous, as to appear more like a simple mucous substance enveloping the body, than like a membrane. In these animals, as in reptiles and serpents, the cuticle is detached at certain periods of the year.

The principal appendages of the cuticle in the inferior animals are, the claws, hoofs, and horns, similar to the nails in man, and the hair and feathers analogous to the human hair.

The claws that are found in most of the *mammalia*, and in birds, and the hoofs that are attached to the feet of a great variety of quadrupeds, are very similar to the nails of the human body, except that they are of a firmer consistence, and composed of a greater number of layers. They are always attached to the distal *phalanges* of the toes, and, like the human nails, grow from the root.

The horns, that constitute the chief offensive and defensive weapons in the *pecora* of Linnæus, differ considerably in their nature, their attachments, and duration. In some animals they are bony substances, as in the deer tribe, and in the *giraffe* (*camelopardalis*) but in the latter they are real processes from the frontal bones, while in the former they are fixed to these bones only for a certain time, and are generally cast off and renewed every year. These bony horns have no immediate connection with the cuticle, and must be distinguished from those which we are now to mention, and which appear to be real appendages of that membrane.

Those horns which decorate the foreheads of goats, antelopes, sheep, and cattle, are very similar to each other, and all resemble, in their texture and chemical properties, the nails and claws. They are generally of a conical form, broadest at the base next the skull, whence they sometimes grow in a straight direction, though more generally they are more or less curved. In their central part they are hollow, corresponding to the bony processes of the frontal bone on which they are fixed. They are formed of plates, or concentric layers, and these layers consist of fibres, appearing like a collection of hairs agglutinated together. On their peripheral surface these horns are sometimes smooth and uniform, as in the cow, while in other cases they are either formed into rings, or are spirally twisted. The horny matter of which they are composed appears to be secreted by a membrane lying between their central surface, and the frontal bone. The beaks of birds are composed of a substance similar to horn. The peripheral part of the spurs that are found in some of these animals, is of the same structure, but their central part is composed of a bony process from the leg.

All the mammalia appear to have hair on some part of their bodies; but in a few animals of this class, as in the elephant and rhinoceros, the hairs are very thinly scattered. In some species they are extremely fine, as in the camel, and several species of *viverra ;* while in others they are coarse and thick, forming bristles, as in the hog, and whiskers of many quadrupeds; or quills, as in the porcupine. In general they are cylindrical, like the hairs of man, but in some cases they are flat, as in the *ornithorynchus,* the porcupine, and in the whiskers of the seal.

We have said that the body of young birds is furnished with a few hairs These grow in small bundles from a bulbous root, which forms the rudiment of the future feather. In a few days after birth, the feather may be seen emerging from a small black cylindrical tube, through which it is supplied with nourishment. The first feathers that appear are those of the wings and tail, in the form of down, which is produced before the quill feathers. The shaft of the feather is at first merely a cylinder of gelatinous matter, penetrated by blood-vessels, and having a conical extremity harder than the rest of the shaft, and covered by a layer of black matter, which is the rudiment of the future barbs. This black matter splits as it dries, and forms the first barbs. All birds moult, or change their feathers, once a-year; but all the feathers do not fall off at once.

In the Mammalia, the skin is thickest in the elephant, rhinoceros, and the walrus ; on the contrary, it is in some others extremely thin, especially where it constitutes the wing of the bat. In general, it is thicker on the dorsal than on the sternal part of the body. Its papillæ are most remarkable on those parts which correspond to the fingers and toes of man, but their form is extremely various in the different species, and in different parts of the same species. In some species, as the badger, and honey-weasel, the skin is very loosely attached.

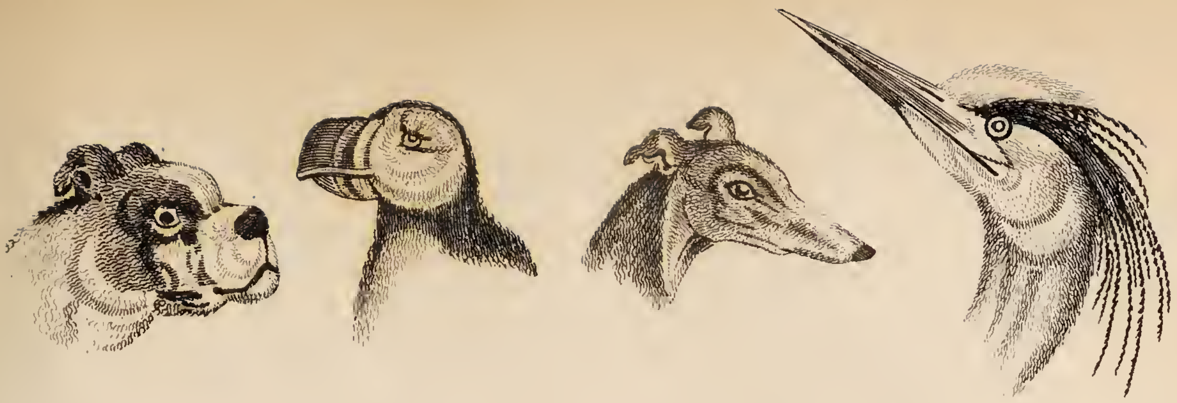
Though all animals appear more or less sensible to the impressions of light, many of them do not possess organs of vision. With the exception of one or two species, however, all the mammalia, cetacea, birds, fishes, reptiles, serpents, and insects, possess eyes. Of the mollusca all those called *acephalons*, as well as many other tribes, have no eyes; all worms and zoophytes are also deprived of these organs.

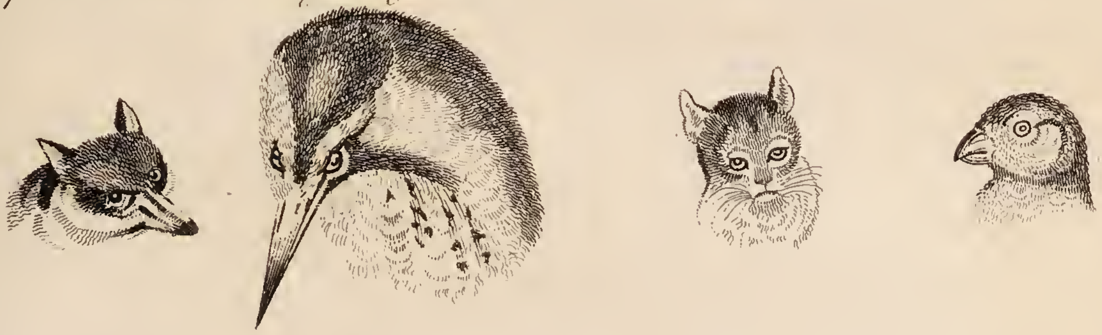
The eyes differ little in respect of number, except among insects, of whom some have two eyes, like most other animals; some have six or eight; while others, from the complex structure of their eyes, may be said to have some hundreds, inclosed within one external covering. In the ape tribe, the eyes, as in man, are directed forwards; but in most other animals they assume a different direction. In quadrupeds and birds they look side-ways, and in some fishes they are both on one side. Several animals, as most of the crustacea and snails, have their eyes placed on pedicles, thus admitting of free motion in every direction.

The component parts of the eye-ball differ very much in different classes. The crystalline lens is proportionally smaller in man, and larger in fishes, than in any other animals. In the latter class it is perfectly spherical. In birds, again, it is remarkably flat; and in these the aqueous humour is very abundant, whereas it scarcely exists in fishes. The dark substance that in man lies between the *retina* and choroid coat, is not found in a great variety of animals. It is most remarkable in the carnivorous and ruminating quadrupeds, in the *solipeda*, *pachidermata*, and *cetacea*, and in most birds. It is of a lighter colour in those animals that seek their prey in the night. The figure of the pupil differs considerably. In some animals it is circular, as in man; in others it is oblong, either vertically, as in the cat tribe, or horizontally, as in the horse and ruminating animals; and in one instance, as in the dolphin, it is heart-shaped.

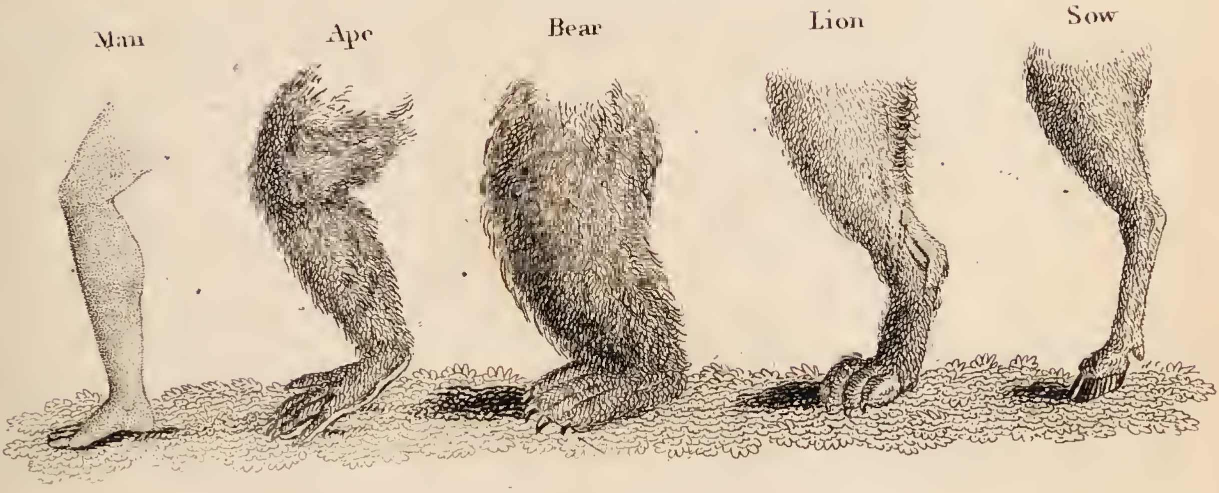
The eyes of mammalia do not materially differ from those of man, except in a few particular species. Part of the choroid coat in most of the carnivorous quadrupeds which prey by night, and in the *bisulca*, is of a most brilliant yellow, green, or sapphire-blue colour on its central surface. This coloured portion is called *tapetum lucidum*. In some species, especially the hare and rabbit, the *retina* has very evident medullary fibres running in a transverse direction.

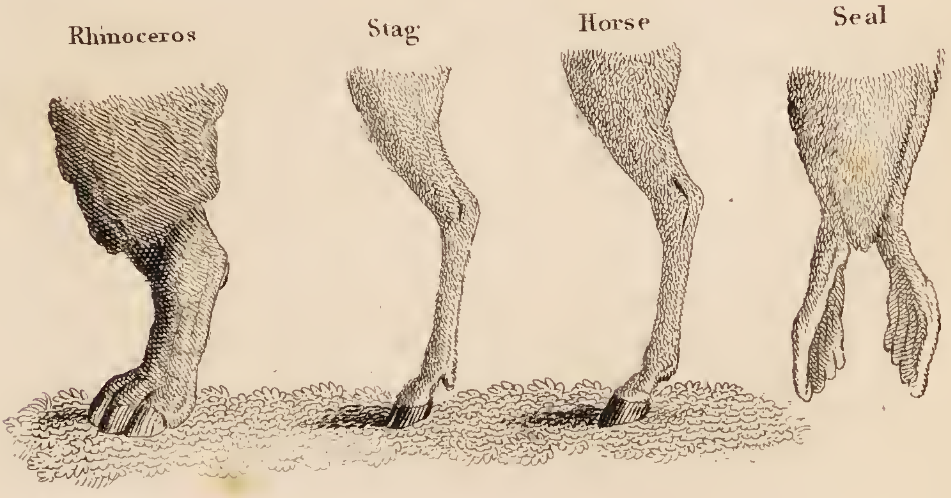
With respect to the humours of the eye, the crystalline is the most remarkable for its varieties. In all mammalia, this lens is more convex than in man, but its convexity is the greatest in the seal and opossum. In many quadrupeds there is a third eye-lid, situated in a vertical position towards the mesial angle of the eye.





Comparative Physiognomies of Birds & Quadrupeds.





Comparative Legs of various Animals.

This is commonly called the *nictitating* membrane, and is most remarkable in the elephant, the cat tribe, the opossum, and the seal. Many quadrupeds have no *puncta lachrymalia;* and in the elephant there is neither lachrymal sac nor ungual bone.

The eyes of birds are larger in proportion to the size of their heads, than those of most other animals, and the orbits in which they are placed, besides being very large, are unusually shallow, and much rounded next the brain. The *cornea* is exceedingly convex. In birds, the basilar eye-lid is larger and more moveable than the coronal or upper lid, and the nictitating membrane is in them more remarkable than in quadrupeds, and is so large and moveable as, when fully expanded, to cover the whole eye-ball. It is furnished with two considerable muscles, by the united action of which the membrane is drawn *laterad* and *iniad.*

Almost all quadrupeds and cetacea; all birds, reptiles, serpents; most fishes, several mollusca, most crustacea, and insects, in their larva state, possess organs of mastication, though these are very different in the several classes, and even in different tribes of the same class. The mandibles of the bill in birds perform in some measure the office of jaws. They are composed of a horny substance, articulated to the cranium, either by ligaments, as in the basilar (and in parrots the *coronal*) mandible, or by bony plates, as in the coronal, admitting however of so much motion, that, in almost all birds, the coronal as well as the basilar mandible is moveable. The form and relative proportions of the bill in birds vary according to the nature of their food. As this organ forms a very prominent feature in their external habits, its varieties have greatly assisted the naturalist in discriminating the character of the orders and *genera* of these animals.

Several of the mammalia either want teeth altogether, or have only a few grinders. This is particularly the case with the ant-eater, and the *ornithorynchus.* The teeth of mammalia, like the bills of birds, are employed by naturalists as discriminating characters of the genera, and will, therefore, require our particular notice in treating of the classification of these animals under mammalia. We shall here remark only a striking difference that is found to exist between the teeth of carnivorous and those of phytivorous or herbivorous animals. In the former, the enamel, or *cortex striatus,* forms, as in man, the peripheral layer of the tooth, though in some, as the rodentia and the hippopotamos, this substance is confined to the antinial or anterior portion of the tooth. In the latter, especially in the *ruminantia,* the grinders, and sometimes the incisors, have perpendicular processes of enamel descending into the substance of the tooth, and connected with the bony part through the medium of a third substance, called by Blake *crusta petrosa,* and by Cuvier, cement. The distinction of these three substances is most distinctly seen in the grinders of the elephant, and has been described and figured by Dr. Blake, in his 'Essay on the Structure and Formation of the Teeth.'

Among the *cetacea,* many tribes and species have teeth, similar to those of the mammalia, but in the *narwhal,* or unicorn-fish, there are only two (sometimes only one) long twisted tusks, of a hard, white, elastic substance, like the tusks of the elephant; and in the genus *balæna*, instead of teeth, there is, in the upper-jaw, a peculiar horny substance, growing from the palatine arch in perpendicular planes. Among the reptiles, frogs and toads have no teeth, but the edges of their jaws are denticulated, like those of many birds. In lizards, however, there are numerous teeth, which have a peculiarity of structure, for the purpose of facilitating their change. The permanent teeth are inclosed within the temporary, as in a shell, and this shell slips off at the time of change.

A great variety takes place in the teeth of fishes. Their most common appearance is that of simple teeth, formed of a bony substance, covered by enamel, as in most of the mammalia, though in fishes the root is firmly united to the socket. In other cases, the teeth adhere only to the gum, or to a firm cartilaginous substance covering the jaw, as in the shark. These teeth appear to be formed, not as in the mammalia, by a deposition of successive bony layers, but by the gradual ossification of a cartilaginous substance. Most fishes have teeth attached to the palate as well as the jaws.

The most striking differences in the stomachs and intestines of the mammalia, respect the number and situation of the former, and the length of the latter. In the carnivorous quadrupeds, and in some of those that are herbivorous, the stomach is single, and in most of the former its structure differs little from that of the human subject, but its coats are usually stronger and more muscular. In many of these animals the division of the cavity into cardiac and pyloric portions, is very evident; and in a few instances, as in the horse, the ass, the hare, and the rabbit, it is very remarkable and permanent. In these animals, the two portions of the stomach differ much in structure, one part being smooth and membranous, the other muscular and corrugated in its central surface. Some of the carnivorous quadrupeds, however, have the stomach divided into more distinct portions or separate cavities. Thus, in the hamster there are two stomachs; in the kangaroo three; and in the sloth four.

The division of the stomach into distinct cavities is most remarkable in the ruminantia. All these animals have four stomachs, differing in structure and appearance, so that they have been distinguished by particular names. The first of these, and the largest in the adult animal, is the paunch. This is divided externally into two portions, and on its central surface, where it is beset with numerous flattened papillæ, there is an obscure division into four parts. The second stomach is much smaller than the former, to which it might be considered as an appendage, but for the very different appearance of its central surface. This is marked with numerous shallow cavities or cells, of an angular figure, resembling the cells of a honey-comb, whence this stomach is sometimes called the honey-comb bag, though it is better known by the name of the king's-hood. Next to this is the smallest of the four cavities called the *many-ples*, from the numerous broad doubling of its central membrane. The last portion is the *abomasum* or red, which is of an oblong conical figure, not much inferior in size to the paunch, and marked within with several longitudinal furrows.

The first three of these divisions are connected with each other, and with the gullet in a remarkable manner. The gullet enters just where the paunch, and the second and third stomachs approach each other, and is continued to the third stomach by a peculiar groove, with thick, prominent lips, which admit of being drawn together, so as to form a perfect tube. Thus, when these lips are closed, there is a communication only between the gullet and third stomach, while in the ordinary relaxed state of the groove, the gullet communicates with the first and second, as well as with the third stomach.

In those ZOOPHYTES which are called *polypes*, the whole animal may be said to consist of stomach, as it is chiefly composed of a membranous tube for receiving and dissolving its food; furnished with tentacula round its only orifice, for seizing and detaining it.

In all animals, except the zoophytes, there is an intestinal canal distinct from the stomach, though in some classes and tribes this distinct tube is very short and simple. It is most remarkable in the MAMMALIA, CETACEA, and some REPTILES.

In the MAMMALIA, the intestinal canal is in general much shorter in the carnivorous than in the herbivorous animals, though to this there are few exceptions. Thus, in the seal, which lives chiefly on fish, the intestines are very long, while in the sloth, which is entirely herbivorous, they are extremely short. The length of the canal is greatest in the *ruminantia* and *rodentia*, being sometimes, in the former, in the proportion of twenty-seven to one of the length of the body, and in the latter, in that of twelve or sixteen to one.

The intestinal canal of BIRDS is proportionally much shorter than in *mammalia*, but it is longer in the granivorous than in the carnivorous birds. The distinction into small and large intestines is very obscure, though in most birds there are two expansions of the canal, which we may call *cæca*. In all birds the *rectum* terminates in a particular expanded membranous cavity, called the *cloaca*, from the circumstance of its affording a common outlet to the excrements, and the eggs. The form of the *cloaca* varies in the different species; and that part of it through which the egg passes, and which has been called *bursa Fabricii*, is of an oval figure, and of a size proportioned to the eggs which are to pass through it. It is also largest in young birds. The *villi* in the small intestines are numerous and long, and have an elegant appearance. They are most distinct in granivorous birds.

The heart in MAMMALIA scarcely differs in its internal structure from that of man, except that in some of those animals, as in the stag and the hog, there are two small flat bones situated at the origin of the *aorta* from the systemic ventricle. The situation of the heart in these animals is, however, different, as it rests rather on the *sternum* than on the diaphragm, and its *pericardium* has very little connection with the latter. The heart of *mammalia* is not, except in a few of the ape tribe, that approach very near the human species, placed obliquely. The general distribution of the blood-vessels is, in most mammalia, similar to what takes place in man, but in a few species, some of the arteries are disposed in such a manner as to check the *impetus* of the blood. Thus, in several of the ruminating *bisulca*, the internal carotid artery, at its entrance into the skull, is divided into a great number of very small tortuous branches, which soon after re-unite into a single trunk, forming the appearance called *rete mirabile.* Again, in some of the slow moving quadrupeds, as the Slow Lemur *(lemur tardigradus)* and the Sloth (*bradypus tridactylus,*) the arteries that supply the muscles of the limbs are divided into a great many equal sized parallel cylinders, which, after running for some distance, again unite.

The heart of BIRDS possesses a peculiarity of structure which deserves notice. The pulmonic ventricle, instead of the membranous valve which we described in man by the name of *tricuspid valve*, is furnished with a strong tense muscle, of nearly a triangular form, the contractions of which must contribute to impel the blood with greater force through the lungs. The systemic ventricle has the usual mitral valve.

In FISHES, the heart is also simple, and very small, but the distribution of the blood-vessels differs from that of all other animals. A single arterial trunk rises from the ventricle, and in most fishes is expanded as it leaves the heart. This trunk passes immediately to the gills, through which it distributes the blood, and this fluid is then collected into a large artery, analogous to the systemic artery of warm-blooded animals, from which the blood is sent over the whole body, and is brought back by large veinous trunks to the auricle of the heart. The blood-vessels of fishes are also few in number, though there are a great many colourless vessels (*exhalants)* arising from the arterial system.

All animals respire air, either immediately, or through the medium of the watery fluid in which they live ; but the organs by which this function is performed are extremely various in the different classes. In all those animals that have a perfect system of circulating organs, respiration is carried on by lungs or gills ; while in those that have no proper circulating vessels, the air is either respired by means of *tracheæ*, (air tubes running below the skin, and communicating with the surface by numerous openings,) or it seems to penetrate through the pores of the peripheral integuments to every part of the body. With respect to their respiratory organs, animals may be divided into four classes. In the first class, respiration is performed by means of lungs, as in MAMMALIA, CETACEA, BIRDS, REPTILES, and SERPENTS ; in the second, it is carried on by means of gills, as in FISHES, and several CRUSTACEA ; in the third, the air is respired by means of *tracheæ*, as in INSECTS and most MOLLUSCA ; and in the fourth class, the air passes through the pores of the cuticle, as in WORMS and ZOOPHYTES.

The organs of respiration in BIRDS are singular in their structure, situation, and extent. The lungs are comparatively small, of a flattened form, and are situated between the *pleura* and the ribs. They are not divided into lobes, as in *mammalia*, but consist of a great number of large cells, extended for a considerable length both through the thorax and part of the abdomen. Interspersed among the cells, there are several bundles of muscular fibres, which seem in these animals to supply the want of a diaphragm. The cartilages of the wind-pipe in birds are perfect circles, and overlap each other.

The respiratory organs of birds are not confined to the lungs. The air is diffused through the cavities of the bones, and even in some cases through analogous cavities in the muscles, especially below the pectoral and scapular muscles. This greater diffusion of air through the bodies of birds seems necessary to fit them for motion through the atmosphere; and accordingly we find, that in those birds which soar highest, as the eagle, hawk, stork, and lark, the cavities in the bones, and below the muscles, are larger than in other birds.

Most of the MAMMALIA agree with man in the general form of the *larynx*, but its internal structure varies in almost every tribe. In particular, those quadrupeds which have appropriate voices, as the horse, the ass, the cat, the pig, &c. have peculiar membranes running across the glottis, on the mechanism of which the peculiarities of their voices seem to depend. Thus, according to Blumenbach, the neighing of the horse is effected by a delicate membrane, nearly falciform, which is attached by its middle to the thyroid cartilage, and has its extremities running along the external margins of the opening of the *glottis.* The braying of the ass is produced by means of a similar membrane, under which there is an excavation of the thyroid cartilage, and the sound is probably increased or modified by two large membranous sacs, opening into the *larynx.* A similar structure prevails in the mule, whence that animal brays like its parent ass.

BIRDS may be said to have two *larynxes,* one at each extremity of the wind-pipe, and both furnished with openings that answer to the glottis of *mammalia.* The aperture next the head differs from the glottis of *mammalia,* in having no epiglottis. The aperture next the lungs is more complex than the former, and appears to be the principal organ of voice in birds. It consists chiefly of an oblong opening, formed by tense membranes, and furnished internally with several muscles, by which the aperture may be more or less contracted. In several species, especially among aquatic birds, there are peculiar windings in the wind-pipe, while in others this tube is perfectly straight.

There are several secretions of a peculiar nature among the inferior animals, and these we must briefly notice, though the nature of our plan does not permit us to describe with any minuteness the organs by which they are produced. Among the MAMMALIA, the most remarkable secretions are those of *castor,* secreted by glands found near the end of the *rectum* in the beaver; of civet, in the civet-cat (*viverra cervetta;*) of musk, secreted by a pouch situated within the prepuce, near the navel of the male musk animal (*moscus moschiferus;*) and those very fœtid emanations that proceed from the bodies of several species of *viverra,* when injured or attacked.

In the CETACEA there are two peculiar secretions that merit notice, viz. those of *spermaceti* and *ambergris.* The former is a concrete oil, found about the head of several whales, especially the *physeter macrocephalus*, or spermacetti whale; the latter is generally considered as a concretion formed within the intestinal canal of the same animal.

The most remarkable secretion in BIRDS is that of the oil with which they lubricate their feathers, and which is secreted by peculiar glands situated on the rump at the root of the tail. These glands are largest in aquatic birds, and in one species, the *anas moschata*, the oil has a musky odour.

The animal senses are necessary powers by which their existence is rendered compatible with loco-motion: and this is evident by considering their uses to the animal, and by observing their various powers as posessed by different animals. Natural History does little more than record those phenomena. The powers or senses evident in vegetables and trees are, the principle of growth, the power of propagation, and the capacity of appropriating nutriment to their sustenance; all mechanical and insensitive; forming a species of existence like that of an animal asleep, whose mechanical functions, as we all know from our sleeping experience, proceed without consciousness. Its state of existence requires no further powers, and no others are evinced, or are perceptible.

On the other hand, the essential qualities of loco-motive beings of the highest order, appear to consist of,

1. Their physical powers,
2. Their perception of feeling,
3. Their power of volition,
4. Their organs of sense,—and
5. Their powers of reminiscence, and reasoning by analogy.

Their growth and definite size of vegetables and animals is another analogy of their existence, and arises from their assimilation of food, or nourishment, by their roots; while their perspiration and evacuations are in fractional proportions to their assimilation. Thus a certain series of regular increase and proportionate decrease, measure and determine certain augmentations in the growth of all organized bodies, during given intervals of time; and the fixed laws of aggregation produce, in consequence, all the definite effects which we witness in nature!

All classes of organized beings, which acquire a certain bulk in equal periods of time, are therefore governed in the law of their increase by the same definite powers of simultaneous increase and decrease, as may be expressed by corresponding series of numbers; and, having acquired, or approximated to, the bulk designated by the appropriate series, they remain stationary; and afterwards decay, by a converse operation of the same powers and series.

Animals consist, universally, of a basis of bones, for strength—of a continuity of muscles, for motion—of a medullary system of brain and nerves, for sensation, comparison, and retention—of respiratory organs, for appropriating gaseous atomic motion,—of a stomach to re-supply the waste of perspiration—and of arteries and veins, for circulating nutriment, and the excitation of warmth to the whole.

In the general economy of nature, if we regard the generation of atmospheric gas, as an evolution at once of the mundane motions and the solar pulsations, powers which might in time generate indefinite atmospheres, and dissipate all the volatile matter of the earth, we may regard the animal economy as counteracting, in the infinite number and variety of animal existences, the effect of those causes, and serving as means of refixing the circulating atoms, and returning them in fixed forms to the earth, to serve again as pabula of future successions of vegetable and animal organizations.

The final cause of animal existence, indicated in the preceding observations, accords with the necessary equality of all cause and effect, and to the harmony and fitness of all co-existent beings; but the detailed arrangements concurring to produce that equality and harmony by means of separated powers, always affords evidence of the pre-existence of a sublime cause of causes, or of an OMNISCIENT, and OMNIPOTENT ARCHITECT of the WHOLE.

Far as creation's ample range extends,
The scale of sensual, mental pow'r ascends:
Mark how it mounts to man's imperial race
From the green myriads in the peopled grass;
What modes of sight betwixt each wide extreme,
The mole's dim curtain, and the lynx's beam;
Of smell, the headlong lioness between,
And hound sagacious on the tainted green;
Of hearing, from the life that fills the flood
To that which warbles through the vernal wood!
The spider's touch, how exquisitely fine!
Feels at each thread, and lives along the line;
In the nice bee what sense so subtly true
From poisonous herbs extracts the healing dew.
How instinct varies in the groveling swine,
Compar'd, half-reasoning elephant, with thine!
'Twixt that, and reason, what a nice barrier!
For ever separate, yet for ever near!
Remembrance and reflection how allied;
What thin partitions sense from thought divide!
Yet middle natures, how they long to join
Yet never pass th' insuperable line!

In comparing animals with man, and in considering what are called the INSTINCTS of animals in opposition to the free-will of man, we ought to bear in mind, that every end is effected by a number of *particular* steps. But, in treating of animal instincts, we are apt to look only to the end, and to forget the intermediate steps. Thus, we say, that birds build their nests by instinct, and we support the position by referring to the uniform structure of the nests of each species. We conclude, therefore, that there is no special contrivance, no invention; and that one nest is so like another, that the bird acts under a necessity, or by a mechanical impulse, which we call a natural faculty or instinct. But in this we look only at the end, at the finished nest, which, though like other nests, yet would and must have been constructed under a great and almost infinite variety of circumstances. Every change of situation, of weather, of season, of place, of position, of shrub, of mate, of materials, and of food, would call for particular exertions; and for reasoning and contrivance arising out of those varied circumstances. All these particulars fill up the life of the bird, and call for varied contrivance and reasoning, before the nest can be finished.

To overlook this variety of circumstances, and necessary variety of action and motive in the individual birds who have constructed similar nests in various trees and places, is to abandon that reason, and that power of tracing an effect to its causes, which has been the boast of human intellect! What if animals were thus to reason of man? Is he not the creature of his convenience, his habits, and his physical nature, like the animals whom he ignorantly despises? May not the birds of Caffraria view the similar kraals of Hottentots as the ends of Hottentot life and labour? Yet they would be as irrational and stupid as those pretended philosophers who talk of animal instinct, if they considered those kraals as the product of blind impulse, and did not justly estimate the reasoning attendant on the varied circumstances of their separate production?

That birds build their nests alike, and that the same species of all animals have analogous habits, arises from the same cause that men do not swim like whales, fly like eagles, or crawl like serpents. Should either of these creatures make his own habits the standard of perfection, he would describe man as the slave of his physical powers, and as the creature of certain habits and prejudices, which prove that he is governed by instincts, and unable to enjoy the pleasures either of swimming, flying, or crawling! It is evident, nevertheless, that man possesses higher powers of reasoning than any animal; that he is at the head of loco-motive thinking creatures; that his powers of intellect transcend those of the elephant, as much, perhaps, as those of the elephant transcend those of the oyster.

This, however, may be true, without sinking animals which are inferior to man down to the level of mechanical organizations. Among men themselves are to be found all degrees of intellect; some individuals of every nation, and some whole tribes, little superior to many brutes; yet we concede to them powers like our own, but inferior in sensibility and discrimination.

If then we would think and act as rational creatures, let us decide on the intellects of other animals by general results, which arise from habits, education, and natural powers, such as those which determine and characterize man himself; but let us estimate them by the details of their actions, and by circumstances which decide their preference in doing one thing rather than another, and which details and circumstances make up the life of intellectual beings. Much reasoning might, however, be spared on this subject; for the argument would, perhaps, be shorter, if the persons who talked of instinct were asked what they intended by it. I fear their answer would prove, that they were of that class of thinkers who either do not know that every effect must have a cause, or they would fill the world with as many causes as these instincts! Let then the insolent term instinct be struck from the philosophical vocabulary, with its analogous term occult; and it were to be wished that the vocabulary were further weeded. If one who finds a watch deems it evidence of an intelligent artist, so he that finds a nest, or a honey-comb, or a spider's web, should be led to ascribe intelligence to the maker, and not consider it the work of a mechanical instinct, because he does not understand the language, powers, and habits, of the creatures that made them.

If animals do not reason from experience and appetite like man, but from innate impulses, how is it that man has none of those innate impulses, and that we find it so easy to account for the origin of all our ideas by the inlets of the senses, with which senses animals are also provided in common with man?

After all it would appear, that the habits of all animals (man inclusive) are necessarily dependant on their bodily powers and structure, and, in that respect, dependant on nature and governed by reasoning, education, and convenience, which, to other animals of different habits, must have the appearance of something like what we call instinct. All have habits respectively adapted to their strength, appetites, and relative circumstances; and these habits are created by education and experienced convenience, generating a sort of law of various species. Hence, a crow is not more the slave of instinct in building his nest on the top of a tree, than a beaver in building his house in a stream, or a man by the side of it, or under a hill, to protect it from the northern blasts. If man deviates, it does not destroy the common law, but it proves that he is influenced by other motives; and, if his houses are of various structure, it merely proves that he can form combinations, as well as imitate.

Sense of wrongs or of invaded rights begets in all animals irritations, called passions. These real or supposed wrongs are multiplied as rights become numerous and complicated; but, among animals of simple habits, possession is the only admitted right, and among the same species is seldom disputed; the moral law of doing as they would be done unto, appearing to be the result of the experience of all animals, in a state of unsophisticated nature. Different species invade each other's rights; but man, regardless of the natural rights of all, is the remorseless, wanton, and cruel tyrant of the entire race of animated beings; vyeing with the hyena and other beasts of prey, in selfish, fanciful, and unceremonious destruction. Beasts of prey kill for food; but man kills not only under pretence of getting food, but in sport, for avowed diversion, from supposed convenience, or capricious aversion.

It is observed that the passions of animals are governed by the nature of their food. The graminivorous, dependant on vegetables, has no motive for hostility to other animals, and therefore generally peaceable and harmless; but the carnivorous, being in the habit of destroying and shedding blood, are cruel and merciless. Indeed, Pope refers many of the bad passions of men to this cause, observing, that,

Just disease to luxury succeeds,
And every death its own avenger breeds;
The fiery passions from that blood began,
And turned on man, a fiercer savage, man.

Mutual forbearance and deference, by which men gain by their own concessions the concessions of numbers, appears to be the foundation of human morals, and of the golden precept *of doing as you would be done unto*, which we are assured, on the highest authority, includes the law and the gospel. From this precept proceed the virtues of BENEVOLENCE, CHARITY, TEMPERANCE, and INDUSTRY, which, united in the human character, justly place the possessor at the summit of the Creation, without this, or if the slave of vice, man sinks below the brutes, and is more mischievous, because more powerful. 'Tis virtue, in union with intellectual and cultivated powers, which raise him to heaven, and render him worthy of his Creator.

With thee, serene philosophy, with thee,
And thy bright garland, let me crown my song!
Effusive source of evidence and truth!
A lustre shedding o'er th' ennobled mind,
Stronger than summer-noon, and pure as that,
Whose mild vibrations sooth the parted soul;
New to the dawning of celestial day.
Hence, through her nourish'd powers, enlarg'd by thee,
She springs aloft, with elevated pride,
Above the tangling mass of low desires,
That bind the fluttering crowd; and angel wing'd,
The heights of science and of virtue gains;
Where all is calm and clear; with nature round,
Or in the starry regions, or th' abyss,
To reason's and to fancy's eye display'd;
The *first* up-tracing to the dreary void,
The chain of causes and effects to him
The world producing essence, who alone
Possessing being; while the *last* receives
The whole magnificence of heaven and earth;
And every beauty, delicate or bold,
Obvious or more remote, with livelier sense,
Diffusive painted on the rapid mind.
Tutor'd by thee, hence poetry exalts
Her voice to ages; and informs the page
With music image, sentiment and thought,
Never to die! the treasure of mankind!
Their highest honour, and their truest joy. THOMSON.

These are thy glorious works, Parent of Good,
Almighty! thine this universal frame,
Thus wond'rous fair, thyself how wond'rous then!
Unspeakable! who sitt'st above these heav'ns,
To us invisible, or dimly seen,
In these thy lowest works; yet these declare
Thy goodness beyond thought, and pow'r divine,
On earth, join all ye creatures to extol,
Him first, him last, him midst, and without end.
Fairest of stars, last in the train of night,
If better thou belong not to the dawn,
Sure pledge of day, that crown'st the smiling morn
With thy bright circlet, praise him in thy sphere;
While day arises, that sweet hour of prime,
Thou Sun, of this great world both eye and soul,
Acknowledge him thy greater, sound his praise,
In thy eternal course, both when thou climb'st,
And when high noon hast gain'd, and when thou fall'st;
And ye six other wand'ring fires that move
In mystic dance, not without song, resound
His praise, who out of darkness called up light.
Ye mists and exhalations that now rise,
From hill, or steaming lake, dusky or grey;
Till the Sun paint your fleecy skirts with gold,
In honour to the world's great Maker rise;
Whether to deck with clouds th' uncolour'd sky,
Or wet the thirsty earth with falling showers;
Rising, or falling, still advance his praise,
His praise, ye winds that from four quarters blow,
Breathe soft or loud; and wave your tops, ye pines,
With every plant, in sign of worship wave.
Fountains, and ye that warble as ye flow,
Melodious murmurs, warbling tune his praise,
Join voices all ye living souls; ye birds,
That singing up to Heaven-gate ascends,
Bear on your wings, and in your notes his praise.

MILTON.

THE END.

W. LEWIS, PRINTER, FINCH-LANE, CORNHILL.

INDEX

TO

PARTS V. AND VI., OR VOL. III.

Page

A.

ACTINIA 263
——— *Sociata* 264
Adansonia Digitata, an extraordinary vegetable .. 350
Alderney Cattle 94
Aloe, Great American 442
America, Climate and Products of 350
Anchar 451
Andromeda Polifolia 513
Animated Hedysarum 476
Animal Flower 263
Animals, British 1, 125
——— Savage 3
——— of the Torrid Zone, genera and phenomena of 521
——— and Vegetables, analogy between .. 548
——— vertebral and invertebral 566
——— on the Passions of 582
——— Birds, and Fishes, Comparison of the analogy and differences of 560
——— Classification of .. 564
——— Instinct of, discussed 579
Anise Tree 444
Aquatic Plants 509
——— Animals, Mechanism of 560
Arabia, Horses of 51
Archil 495
Arrow-root, (Indian) 434
Ash Tree 368
Asparagus 490
Aspen Tree 370
Ass 22
Asterias 249
——— Tebor 459
Averrhoa Carambola 476
Aurora Borealis in the Frigid Zone 534

Page

B.

Badger 11
Balsam of Tolu Tree 436
Bamboo 458
Banana Tree 440
Banian Tree 419
——— Cubbeer-Burr 421
——— Peipal ...... ib.
Bat, English 116, 306
—— Foreign, Vampire 119, 304
——— Spectrum .. 305
—— Peruvian 306
Bay Tribe 426
—— Sweet 429
—— Royal 430
Beagles 37
Beans 490
Beaver 95
——— remarkable Habits of the 96
Bee, Description of 307, 550
—— Black .... ib.
—— Shining green .... ib.
—— Variegata 308
—— Mostrata .. .... ib.
—— Smooth black .... ib.
—— Yellowish hairy .... ib.
—— Pale red hairy .... ib.
—— Red hairy ...... ib.
—— Black and hairy .... ib.
—— Red .... ib.
—— Yellow hairy ...... ib.
—— Leaf-cutter, or black .. 309
—— Honey .... ib.
—— Hive, (Mr. Huish's) 313
—— Flower 507
Bees, Economy and habits of 309, 311
—— Directions to Cottagers, concerning 313
—— Peculiarities of 550
Beech Tree 366

INDEX.

Page
Beech, Sea-side 450
Beetle, Stag 272
——— Slow-legged 274
——— Lousy 327
Beings, Loco-motive, Organs and Powers of 578
Betel Tree 456
Birch Tree 371
Birds, British, grand natural divisions of 126
Bison 83
Bittern 217
Blackbird 188
Blackcap 202
Blood Hound 40
Bodies, on the Organs and Functions of 563
Bog Nereis 242
Bohea Tea-plant 400
Botany, Science of, discussed 337
——— various classes of, described 337, 343*
Box Tree 494
Brachinus 268
Brassica 490
Bread Fruit Tree 437
Bruce, Mr., on the Moving Pillars in the Desert 520
Bucke, Mr., his Remarks on Desarts 519
Bull Dog 35
Bullfinch 190
Bustard, Common 182
Butcher Bird 145
——— ——— Lesser 146
Butter Tree 456
Butterfly Tribe 289
——— Equites, or Riders ib.
——— Heliconians .... ib.
——— Danai .. .... ib.
——— Nymphals .... ib.
——— Plebeians .... ib.
——— Papilio 293
——— Peacock's Eye .. ib.
——— Bundle of Dry Leaves ib.
——— Skull 294
Buzzard 135

C.

Cacao Tree, described 404
Cacoons 471
Cactus 469
Camphor Tree 428
——— ——— of Sumatra .. 463
——— ——— of China .... ib.
Canary Bird 194
Candleberry Myrtle 433
Page
Cappoor-Barros 429
Capsular 346*
Carnation 508
Carrion Crow 149
Cashew-Nut Tree 455
Cassia 428
Cat, Domestic 15
—— Local Attachment in a 17
—— Angora 18
—— Wild 19
Cattle, Horned 1
——— Various kinds 83
Caterpillar 296
Cedar 378
——— Durable Properties of the .... ib.
Cetacea 522
Chaffinch 194
Chermes, various 283
Chesnut 367
Cheianthodeadron 501
Cheviot Sheep 111
Chimney Swallow 209
China Rose 508
Chough 154
Chrysalis 289
Cinchona 448
——— Officinalis, or Jesuits' Bark 449
——— Yellow Bark .. 450
——— Sea-Side Beech ib.
Cinnamon Tree 426
——— Wild 428
Cipo 443
Citron, Japanese 386
Clarendon's, Earl of, Deer 4
Cleveland Bays 61
Clove Tree 425
Clydesdale Horse 61
Chocolate 404
Cocoa Tree, American 407
——— Nut Tree ...... ib.
Cock, Domestic 164
——— of the Wood 175
——— Black 176
——— Chaffer 272
Cock's-comb Sponge 240
Cockle 259
Coffee Tree, Growth of the 395
——— Mocha 397
——— Jamaica 399
Coecutiens 322
Coot, Common 219
Coral, ... 239
——— Millepora Alga .... ib.
——— Millepora Polymorpha ib.
——— Warty .... ib.

Page
Coral Tree 431
Corolla of a Flower, various 341*, 343, 505
—— in a Carnation, Description of the 343*
Corallines, various Classes of 554
Cork Tree 459
Cornish Chough 154
Cotton Tree, Growth of the 413
——, Barbadoes .. 414
Cotswold Sheep 107
Cormorant 233
Creeper 162
Cricket, Field 278
—— Hearth 279
—— Mole 280
Crow Tribe 147
——, Carrion 149
Cubbeer-Burr 421
Cuckoo 155
Cullum, Sir T., on Bees .. 311
Currant Tree, Common Red 498
—— Black .... ib.
—— Rhubarb 445
Cygnets 227
Cypress, The 373
—— of Louisiana 465

D.

Danai 289
Dartmoor Sheep 107
Date, Egyptian 383
Death Watch 269, 326
Deer 3
——, Fallow 9
Desart of Sahara 519
——, overwhelming Calamity in the 520
—— Magnificent Phenomena seen at Weadi al Halboub .... ib.
Devonshire Cattle 85
—— Sheep 107
Dionea Muscipula, Venus's Fly Trap, Description of 473, 474
Dishley Sheep 106
Dogs, Varieties of, British, 2, 29, 32, 44
—— Anecdotes of, 31, 37, 39, 40, 42
—— Sea 524
Dormouse 122
Dorsetshire Sheep 113
Dove, Turtle 184
——, Ring .. .... ib.
Dragon Fly 298
Duck 230
——, Tame .... ib.
——, Wild 231

Page
Duck, Eider 233
D'Urva 500
Dunlop Cattle, Breed of .. 94
Dutch Cattle, Breed of .... ib.

E.

Eagle 131
—— Anecdotes of the 132, 133
——, Common ...... ib.
——, Golden .... ib.
——, Sea 134
Earth Puceron 288
——, On Climates, and the distribution of organized Productions of the 514
—— Humboldt's Table of the Temperature of the Surface of 516
—— Professor Leslie's Table 517
Ear-wig 276
Ebony Tree 432
Elder Tree 374
——, Red-berried 375
——, Canada .. .... ib.
Elm Tree 371
Elphinstone, Mr., his description of a Monsoon 530
Ephemera 299
Equites 289
Ermine 71
Exmoor Sheep 112

F.

Falcon, Peregrine 137
Fieldfare 187
Fig Tree, properties of the, 418, 537
——, Egyptian 419
Filament 346*
Fire Fly 270
Fir Trees 375
——, Scotch .. .... ib.
——, Spruce 376
——, Silver .. .... ib.
——, Weymouth 377
——, Larch ...... ib.
——, Wild Pine 378
Fishes, on the Structure of 566
Flax, Common Annual 491
—— Perennial Siberian .. ib.
—— Purging .. .. ib.
Flea, Locust 282
—— Common 325
Flote Fescue Grass 486
Flowers, sensitive class of .. 470
—— Description of 499, 512
—— Forms of 502
Fly, Dragon 298
—— Ephemera 299

Page
Fly, Gad 318
—— Hæmorrhoidalis .... ib.
—— Grey .... ib.
—— Nasalis 320
—— Tarandi .. .... ib.
—— Great Horse 321
—— Breeze .. .... ib.
—— Pluviatilis 322
—— Cœcutiens ...... ib.
—— Gnat .... ib.
—— Horse 324
—— Musquito ...... ib.
Fool Stones 510
Forest Deer 4
——— New, Horse 62
Forests, Vegetation of .. 348
——— in the Torrid Zone 347
Forked Sponge 240
Fountain Tree 432
Fox 12, 13, 15
—— Hound 17
French Cattle 94
Frog Hopper, or Flea Locust 282
Fruits, Exotic, Introduction of 380
——— Trees and Shrubs, Enumeration of principal British 496
Fungusses 495

G.

Gad Fly 318
Galloway Horses 63
——— Cattle 92
Gannet 235
Geranium Night-scented .. 507
Giant Nereis 244
Gloucestershire Cattle 88
——— Sheep 107
Glow Worm 270
Gnat 322
Goat 46
—— Sucker 215
Goldfinch 192
Goose, Wild 227
——— Tame, with Anecdote of the 228
——— Solan 235
Gooseberry, Common 498
——— Prickly Fruited ib.
Gos-Hawk 136
Gourd 464
Grandiflorus 503
Grasses, British, Varieties 485, 488
Greenland, Severity of Cold at 518
Grey Fly 318
Greyhound, Common 38
——— Irish .... ib.
Grouse Tribe 174
——— Red 178

Page
Gryllus, Domestic and Field 277
Guinea Pig 121

H.

Harriers 36
Hare 75
Harvest Mouse 124
Hawk 138
Heart's Ease 508
Heat, Solar 524
Heath Sheep 114
Hedge Hog 26
Hedysarum, Animated 476
Heliconians 289
Hæmorrhoidalis 318
Hen Harrier 138
—— Guinea 171
—— Domestic 165, 167
Herdwick Sheep 110
Herefordshire Cattle .. 86
——— Sheep 109
Heron 216
Highland Cattle 92
Hog 21
Holly 374, 494
Honey-bee 309
Honey-suckle, various 511
Hoopoe 161
Horned Cattle, Indigenous Breed of 1
——— Short ditto (Northern) 90
——— Half-long ditto .. 91
Hornet 302
Horse 1, 50, 55
——— Fine Formation of the 50
——— Arabian 51
——— Race 58
——— Hunter 60
——— Old English Draught ib.
——— Suffolk Punch 61
——— Clydesdale .... ib.
——— Cleveland Bay 62
——— New Forest .... ib.
——— Galloway 63
——— Shelties 64
———s, Anecdotes of, 58, 59, 63, 64
Hound 36
——— Fox 37
——— Grey, Irish 38
———, Common .... ib.
——— Blood 40
Humboldt, M. Catalogue of Plants, by 346
——— Table of average Temperature, by 516
——— Night-scene at Quito described by 52
——— West-India Landscape delineated by ib.

Page
Hunter 60
Hydrophilus Piceus 271
Hybernaculum 357

I.

Ibbetson, Mrs. Microscopical Observations on Vegetation, by 359
Iceland, edible Lichen of.... 495
Indian Arrow Root 434
Indigo, its qualities explained 416
Insects, intermediary Affinities of 544
—— Physical Properties of 547
—— Formation of 551
—— Species of 268
—— the cicindela sylvatica ib.
—— Hybrida ... . ib.
—— Germanica ...... ib.
—— Brachinus .... ib.
—— Lamprias Cyanocephalus .... ib.
—— Staphylinus Nitiadalus .... ib.
—— Ptinus 269
———— pertinax ... ib.
———— fur ...... ib.
———— fatidiculus ib.
—— Fire-fly 270
———— nocticula ... ib.
———— Glow Worm ib.
—— Nitidula 271
—— Hydrophilus piceus ib.
—— Stag-beetle 272
—— Cock Chaffer .... ib.
—— Mordella 273
—— Meal Worm .... ib.
—— Slow-Legged Beetle 274
—— Weevil ... . ib.
—— Lady Cow, or Lady Bird 275
———— White Hedge-Hog .... ib.
—— Ear-wig 276
—— Gryllus, domestic and field 277
—— Frog Hopper, or Flea Locust 282
—— Chermes 283
———— patella 284
—— Vine Fretter, or Plant Louse 285
———— Bonnet on the ib.
———— Trembley on the 286
—— Oak Puceron 287
—— Earth Puceron 288
—— Butterfly Tribe 289
—— Bee 307
—— Maggot 317
—— Oestrus 318

Page
Insects, Oestrus, Breeze, or Gad Fly ... ib.
———— Hæmorrhoidalis ib.
———— Grey Fly ib.
—— Sheep Nose Worms 319
—— Nasalis 320
—— Tarandi ...... ib.
—— Breeze Fly 321
—— Great Horse Fly ... ib.
—— Pluviatilis 322
—— Cœcutiens ...... ib.
—— Gnat .... ib.
—— Horse Fly 324
—— Flea 325
—— Jermes Pulsatorius 326
—— Louse .... ib.
—— Sir John Hill, on a World of, inhabiting the corolla 343*
—— First Families of 549
—— on the Structure of 551
Instinct, Question what it means 581
Instincts, Animal, observations on 579
Irish Cattle 94
Ivy, common 512

J.

Jackdaw 152
Jalap 465
Jasmine 509
—— Arabian 420
Jay 153
Jenghis Khan, saved by an Owl 14
Jermes Pulsatorius 326
Jesuits' Bark 449
———— of Jamaica 450
Jussieu, Natural System of, detailed 339

K.

Kali 492
Kentish Cattle 88
Keratophytum 241
King's-fisher 160
Kirkby, Rev. Mr. on Bees 312
Kite 135
Knot 224
Kyloes 92

L.

Laburnum 430
Lady-Bird 275
Lamprias Cyanocephalus, various 268
Lampyris 270
Lancashire Cattle 88
Lapwing 222
Leaf, Talipot, amazing size of the 351*

Page
Leaf, Troolie 352*
Leaves, Simple 350*
——— Compound 351*
Leech, Medicinal 244
——— Horse .... ib.
——— Geometrical 245
——— Muricated ..... ib.
Legumen 346*
Leicester Sheep 106
Lemon, Sea 250
——— Tree 385
Leslie's, M., Table of average Temperatures 517
Leveret, Mr. White's Account of a 17
Lichens Islandicus, or eatable 495
——— Rangeferinus ...... ib.
Light, Influence of, on vegetation 477
Lime, Tree 373
Limpet, various 251
Lincolnshire Sheep 2, 105
Linnæus, System of, on Plants 337, 343
——— on Pearls 260
——— on the Sleep of Plants 478
Linnet 195
Liver-wort 495
Lotus 478
Louisiana, Cypress of 465
Louse 326
Lowland Scotch Cattle 93
Lurcher 39
Lycopus 513

M.

Madder 492
Maggot 317
Magpie 154
Mammalia, varieties of, 563, 564
——— Dissections of 577
Mangrove Tree 457
Marsh Cistus 513
Martin 71
——— Pine 73
——— (Bird) 211
——— Sand 213
Mastiff 35
Meadow-mouse 125
——— Grass 486
——— Fox-tail 487
——— Cat's-Tail ...... ib.
Meal Worm 273
Medusa, Sea-Nettles, 265, 556
——— Aurited 266
——— Capillated ...... ib.
——— Purse 267
——— Waved .... ib.

Page
Medusa, Mr. Banks's new species of 267
Melolontha 272
Melon 497
——— Cantaleupe 498
Men, gradation of Intellect in 581
——— on the innate principle in ib.
Milk Tree 439
Mimosa, Slothful 470
——— Lively 471
——— Sensitiva 478
Mines, Saxon, vegetation in 352
Mistletoe 493
Mole 99
——— Cricket 280
Monsoons, description of the 530, 531, 532
Mordella 273
Mosses, description of 537
Mostrata Bee 308
MOTHS, Phalena 295
——— Attaci .... ib.
——— Bombyces .. .... ib.
——— Noctuæ .. .... ib.
——— Geometræ 295
——— Fortrices .. .... ib.
——— Pyralides .... ib.
——— Tineæ .. .... ib.
——— Alucitæ 296
——— Platæna Attacus pavonia minor 297
——— Phalæna alucita pendadactyla .... ib.
——— noctua elinguis humuli 298
——— noctua pronuba spirilinguis .... ib.
——— tortrix prasinana ib.
——— Unicorn 345*
Mountains, Vegetation of 346
Mouse 123
——— long-tailed, Field .. 124
——— Harvest .... ib.
——— Meadow 125
Mulberry Tree 497
——— White .... ib.
——— Red ...... ib.
Mule 48
Musquito-Fly 324
Mustard 491
Mushrooms 424, 545
——— Varieties and Affinities of .... ib.
Mussel 256
——— Edible .... ib.
Mussel, bad Effects of the 256
Myrica Wax-Bearing 433
Myrrh, Laurel 430
Myrtle, Candleberry 432

Page

N.

Nature, Animal, on the ascending Links of 537
——— organic contrivances of, animal and vegetable 546
Nasalis 320
NECTARY of various FLOWERS 345*
Aconitum napellus .... ib.
Helliborus .... ib.
Lamium album ... . ib.
Viola ... . ib.
Tetradynamia ... . ib.
Passiflora cœrulea .... ib.
Nepenthes Distillatoria 464
Nereis 242
——— Bog 243
——— Waving 244
——— Giant .. .... ib.
Nettle, sea 263
Newfoundland Dog 42
Night-blowing Cereus 469
Nightingale 200
Nitidula 271
Norfolk Cattle 91
——— Sheep 114
Northern short-horned Cattle 90
——— half long horns 91
Norway Rat 79
Nuthatch 159
Nutmeg-tree 422
Nycantheus 470
Nymphals 289

O.

Oak-tree 363
—— Plane 370
—— Puçeron 287
Oat 489
Oestrus 318
Oil, Castor, Preparation of 385
Olive 446
—— Cape 447
—— Sweet-scented .... ib.
Opium 512
Orange-tree 385
Orchis 507
Organic Bodies, Remarks on 516
Osprey 134
Otaheite, Bread-fruit Tree of 437
Otter 45
OWL TRIBE 139
—— Great-horned 141
—— Long-eared 142
—— White 143
—— Tawny 144
—— Screech 145
Ox 82

Page
Oyster 251
——— of Britain 253
——— Treatment of .... ib.

P.

Pale-red hairy Bee 308
Palm Tribe, Description of the 381
—— Tree 383
Palmetto 384
——— Palma Christi .... ib.
——— Ricinus Americanus 385
Papyrus, Description of the 460
——— Daphne 461
Partridge 178
Passion Flower 508
Patella 284
Peas (various) 490
Peach 496
Peacock 172
Pearl Mya 259
Pearls, large species of 260
Pepper-tree (Jamaica) 431
Pericarpium 346
Peregrine Falcon 137
Pernambucana 470
Peruvian Bat 306
Pettichaps 202
Pheasant, common 168
Phocœ 524
Pigeon Tribe 182
——— Common 183
——— Domestic ...... ib.
——— Amazing speed of a ib.
Pimento Tree 431
Pine-martin 73
Pink, on the 508
Pistil 34
Pitch, Process of Making 377
Plane Tree 370
Plant, Anatomical Analysis of the Parts of a 330, 340
——— Vinegar 441
——— Pitcher 464
——— Moving 476
——— Bashful humble 470
——— Pink 508
Plants, Annual 340
——— Briennial .... ib.
——— Perennial .... ib.
——— on the Native Countries of 354
——— Tropical 381
——— Fructification of .. 341
——— Geography of 345
——— Enumeration of ... 347
——— Division of the classes of 352*
——— Inoculating 358

INDEX.

Page

Plants, on the sensitive and chemical Powers, with examples, of 466
——— Sleep of 478
——— Carbonic acid gas, in the composition of 484
——— on the Exercise of the Functions of ib.
——— Aquatic 509
——— Leguminous 541
——— Colouration of 481
Plantain Tree 439
Plant, Louse 285
Plebeians, Butterflies 289
Pluviatilis 322
Pointer 41
——— Sagacity of the .... ib.
Poison Tree 451
Pole-cat 73
Polyanthus, varieties of the 510
Polypodium 465
Polypi 554
Pomegranate Tree 436
————— American Dwarf ib.
Poplars 369
———, Lombardy 370
Poppy, Spattling 511
——— Common 512
Potatoe 490
Potosi, discovery of 353
Poultry-Tribe 162
——— General Properties of the .... ib.
Prunus, Description of 496
Ptinus 269
——— pertinax ...... ib.
——— fur .. .... ib.
——— fatidiculus ...... ib.
Pucerons, Oak 287
———— Earth 288
Pudica 470
Pumpkin 464
Purse Medusa 267

Q.

Quail 180

R.

Rabbit 77
———, Fecundity of the .. ib.
Race-horse 59
Rains, Observations on ... 533
Ranunculus Aquatilis .. 513
Rat 78
——, Common black .... ib.
—— Norway, or brown .. 79
—— Water 81
Rattle-snake Wort 463
Raven 148

Page

Razor-sheath 261
Red-pole 196
Red-wing 188
Red-start 203
Red-breast 205
———— interesting Habits of the 206
Rezin, Process of Making 377
Rhubarb 444
———— Palmated-leaved Chinese ...... ib.
———— Tartarian .... ib.
———— Undulated 445
———— Currant .... ib.
Rice 462
Ring-Dove 184
Ring-Ouzel 189
Roe 10
Romney-Marsh Sheep 108
Rook 150
Roots, Varieties of 349*
——— Bulbous 357
Rose, China 508
Ruff 221
Rye-Grass 486
Ryland Sheep 159

S.

Sahara, Desert of 519
Sandal-Tree 448
Sand-Martin 213
Sassafras Tree 430
Savage 301
Scandens, or Mafootoo Wyth 471
Scotch Cattle 91
Screech-owl 145
Sea-side Beech-tree 450
Sea-Star 249
———— various Species of the 250
—— Lemon .... ib.
—— Nettle 263, 265, 556
—— Anemone ...... ib.
—— Urchin 555
—— Hedge-hog 556
Seal 120
—— Docile Habits in one ib.
Sedge-bird 205
Seeds of Plants, various ... 347*
Sensitive Plants 472
Setter 42
Sheep 2, 101
——— Without Horns, Lincolnshire 105
———— Tees-Water ib.
———— Dishley, or New Leicester 106
———— Cotswold, or improved Gloucestershire 107

Page
Sheep, Without Horns, Devonshire ... 107
—— South-Down ib.
—— Romney Marsh 108
—— Hereford, or Ryland 109
—— Herdwick ... 110
—— Dunfaced ... ib.
—— Cheviot 111
—— Shetland ... ib.
—— With Horns 112
—— Shropshire ... ib.
—— Dorsetshire 113
—— Exmoor .... ib.
—— Wiltshire ... ib.
—— Norfolk 114
—— Heath-breed ib.
—— Fescue-grass 486
—— Nose-worms 319
—— Anecdotes of 104
Shell, Knife-handle 361
Shelties 64
Shepherd's Dog 34
Shetland Sheep 111
Shrike 145
Shropshire Cattle 90
—— Sheep 112
Siliqua 346*
Silver tree 436
Skylark 197
Sleep of Plants, Opinions on 479
Slug 246
Snail, Edible 247
——, Garden 248
Snipe, Description of the 221
Soap-tree 452
Solan Goose 235
Solen 261
Sombrero, Wonderful Plant of 475
South-down Sheep 107
Sow, Instance of a prolific .. 21
Spaniel 43
Sparkler, various 268
Sparrow hawk 138
—— Family 184
—— Common 191
—— Hedge 203
Spectre 305
Spiders 558
Sponge Class—Branched .. 239
—— Cock's-comb 240
—— Tow .. ib.
—— Dichotomous ib.
—— Stinging .. ib.
—— Palmated .. 241
—— Coronet .. ib
—— Grape .... ib.
—— Creeping .. ib.

Page
Sponge Class—River 241
—— Plant 442
Spring Wheat 488
Squirrel 24
Stag, English 5
—— Beetle 272
Stamen 346*
Stapelai 463
Staphylinus Natiadalus .. 268
Star Fish, or Asterias 249
—— Glacialis 250
—— Cancellated Sea-Star .... ib.
—— Oculata ...... ib.
—— Hispida .. .... ib.
—— Placenta ...... ib.
—— Spherulata ...... ib.
—— Aborescent Sea-star ib.
Starling 185
Stem 349*
Stoat 70
Stock Dove 183
Stone-Chatter 207
Storax-Tree, various 453
—— Benzoin 454
—— Elemifera ...... ib.
—— Catechu 455
—— Nilotica .. .... ib.
Strawberry-Tree 499
Suffolk Punch Horse 61
—— Cattle 92
Sussex Cattle 87
Sugar 389
—— Cane, Cultivation of ib.
—— Process of Grinding and Boiling 390
Sumach, Elm-leaved 441
—— Virginian .... ib.
Swallow 209
—— Chimney 210
Swan, Wild 225
—— Tame 226
Swift 214
Swine 20
Sycamore 419
Syringe Tree 459

T.

Talipot-leaf 352*
Tallow-Tree 462
Tall Oat Grass 487
Tamarind-Tree, ... 435
Tar, Process of Making 377
Tarandi 320
Tartarian Lamb 465
Tea 400
—— plant, species of the 401
—— Chinese cultivation of the ib.

INDEX.

Page

Tea, Japanese, Cultivation of 402
—— Manufacturing process of 403
—— Introduction into Europe of .... ib.
Teal 233
Teak-Tree, various 452
—— Játi cápua .. .... ib.
Teasdale Sheep 2
Tellandsia 494
Terrier 39
Thistle 493
Throstle 187
Thrush, Missel 186
—— Common 187
—— Mocking 189
Tobacco, Common 410
—— Oronooko ...... ib.
Tolu-Tree, Balsam of 436
Trees, Tropical, discussed 381, 446
—— Large, Notice of 363
—— Trunks of 352
—— Grafting of 357
—— Inoculation of 358
—— British Forest 363
—— Tanniferous, Resinous, Turpentine, &c. 538
Troolie-leaf 352*
Tulip, Wild, European 505
—— common Garden .. 506
Trunk, subdivisions of the Vegetable 349*, 352
Turkey 170
Turtle Dove 184
Turnip Fly 274
Turnspit 44
Twite 196

U.

Umbella 348*
Upas 451

V.

Vampyre 119
Vanilla 407
Vegetables and Animals, analogy between 548
Vegetation, on the Component Parts of 328
—— of Mountains 346
—— on the Influence of Light on 477
—— British 485
Views, General, of Vegetables, Insects, and Reptiles 536
Vine-Fretter 285
Vine-Tree 497

Page

Vinegar Plant 441
Violet 509
Virginia Plane Tree 370
Virginian Sumach 441

W.

Wagtail 199
Wales, Sheep of 2
Walnut Tree 373
Warty Coral .. .... ib.
Warwickshire Sheep 24
Wasp, Common 301, 302
—— Small 304
Water Dog 43
—— Rat 81
—— Crowfoot 513
Weasel 66
—— Ferocity of the 67
—— Attachment in a .. 68
Willow, Weeping 372
Weevil 274
Welch Cattle 91
Wheat 488
—— Spring .... ib.
—— Winter .... ib.
—— Thick Spiked 489
—— Polish .... ib.
—— German .... ib.
—— St. Peter's .... ib.
Wheat-Ear 208
Whin-Chat 207
Wild Boar 20
Wiltshire Sheep 113
Wind, Observations on 532
Woodcock 209
Woodlark 199
Woodpecker 157
—— Great Spotted 158
Worm-Meal 273
Worm, Sheep Nose 319
Worms 547
Wren 207

Y.

Yellow Bark, Dr. Relph on 450
Yew, the 372

Z.

Zone, Torrid 533
—— on the Phenomena of 521
—— Products of the 527
—— Frigid, Temperature of the .... ib.
Zoophytes, various Species of 239

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